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Kobayashi

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(54) **IMAGE FORMING UNIT AND IMAGE FORMING APPARATUS**

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G03G 21/12 (2006.01)
G03G 21/10 (2006.01)
G03G 15/08 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 21/12*** (2013.01); ***G03G 15/0891*** (2013.01); ***G03G 21/10*** (2013.01); ***G03G 21/105*** (2013.01)

(58) **Field of Classification Search**
CPC G03G 21/10; G03G 21/12; G03G 21/105; G03G 15/0891
See application file for complete search history.

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(74) *Attorney, Agent, or Firm* — Rabin & Berdo, P.C.

(57) **ABSTRACT**

An image forming unit includes an image bearing body, a developer storage section that stores a developer removed from a surface of the image bearing body, a frame surrounding the developer storage section, a developer conveying member that conveys the developer in the developer storage section in a predetermined conveying direction, and a convex portion that is provided in the frame and pushes the developer conveying member toward the image bearing body.

16 Claims, 17 Drawing Sheets

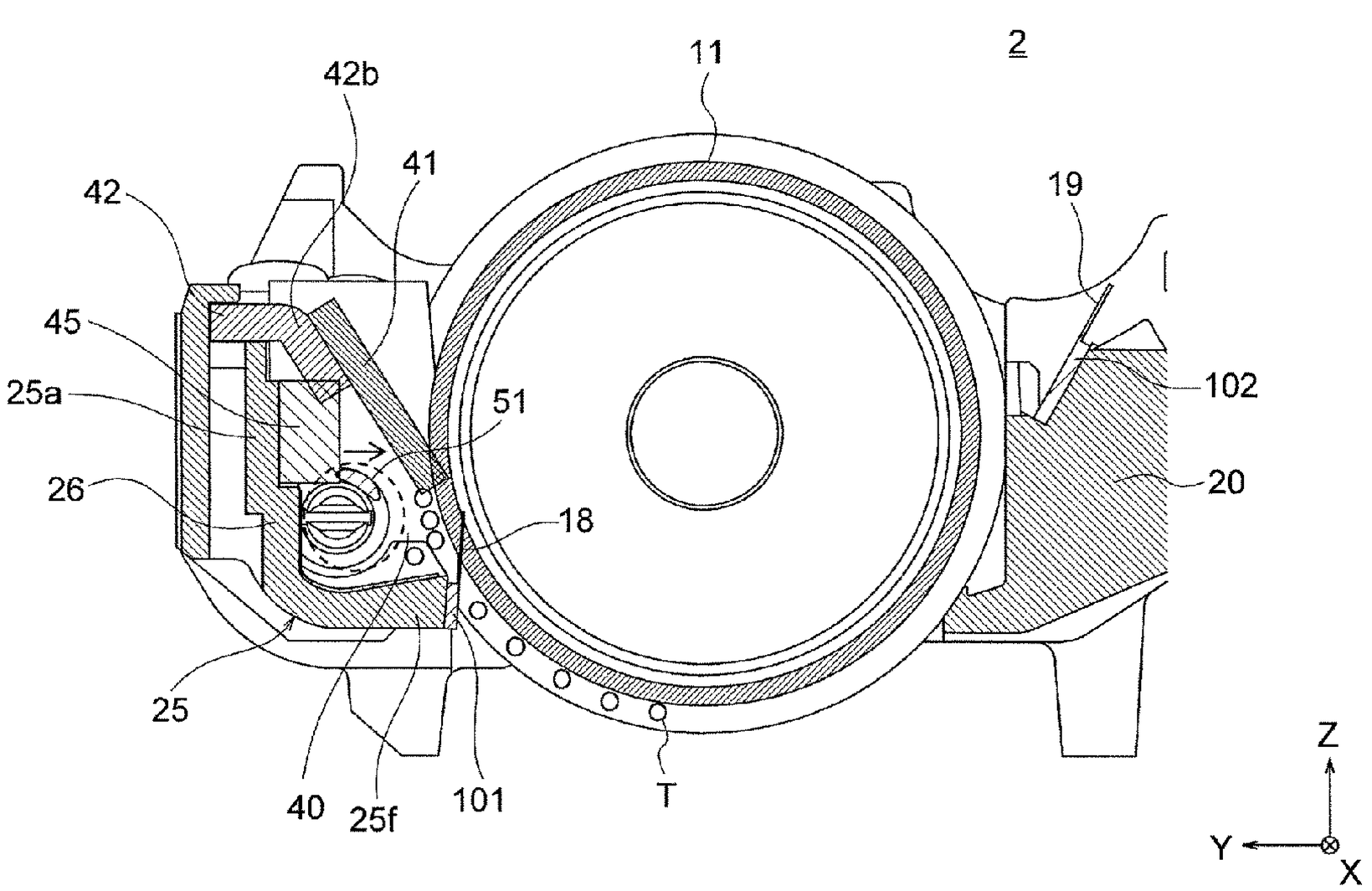
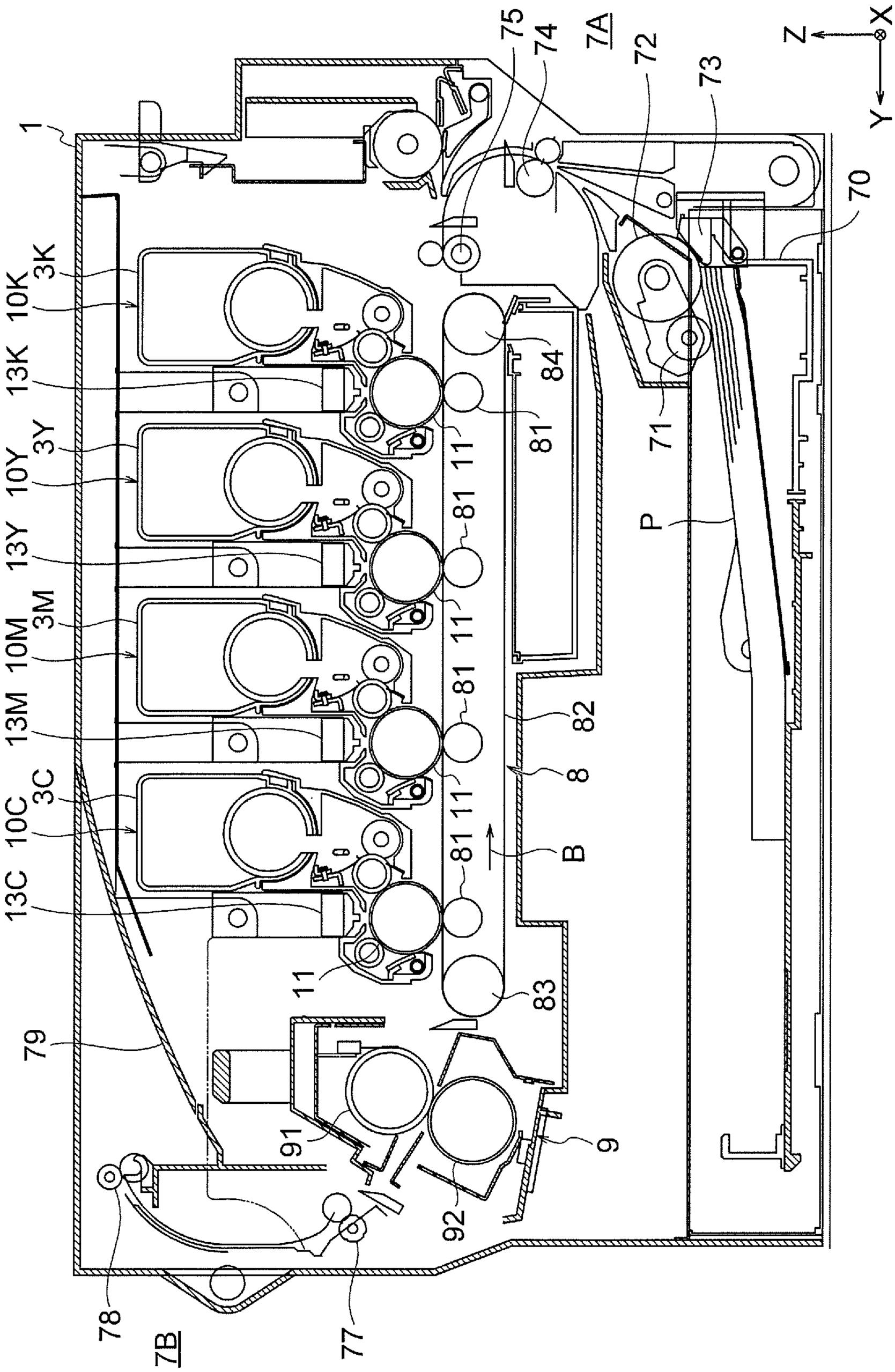


FIG. 1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3K
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13K
3Y
10Y
13Y
3M
10M
13M
3C
10C
13C
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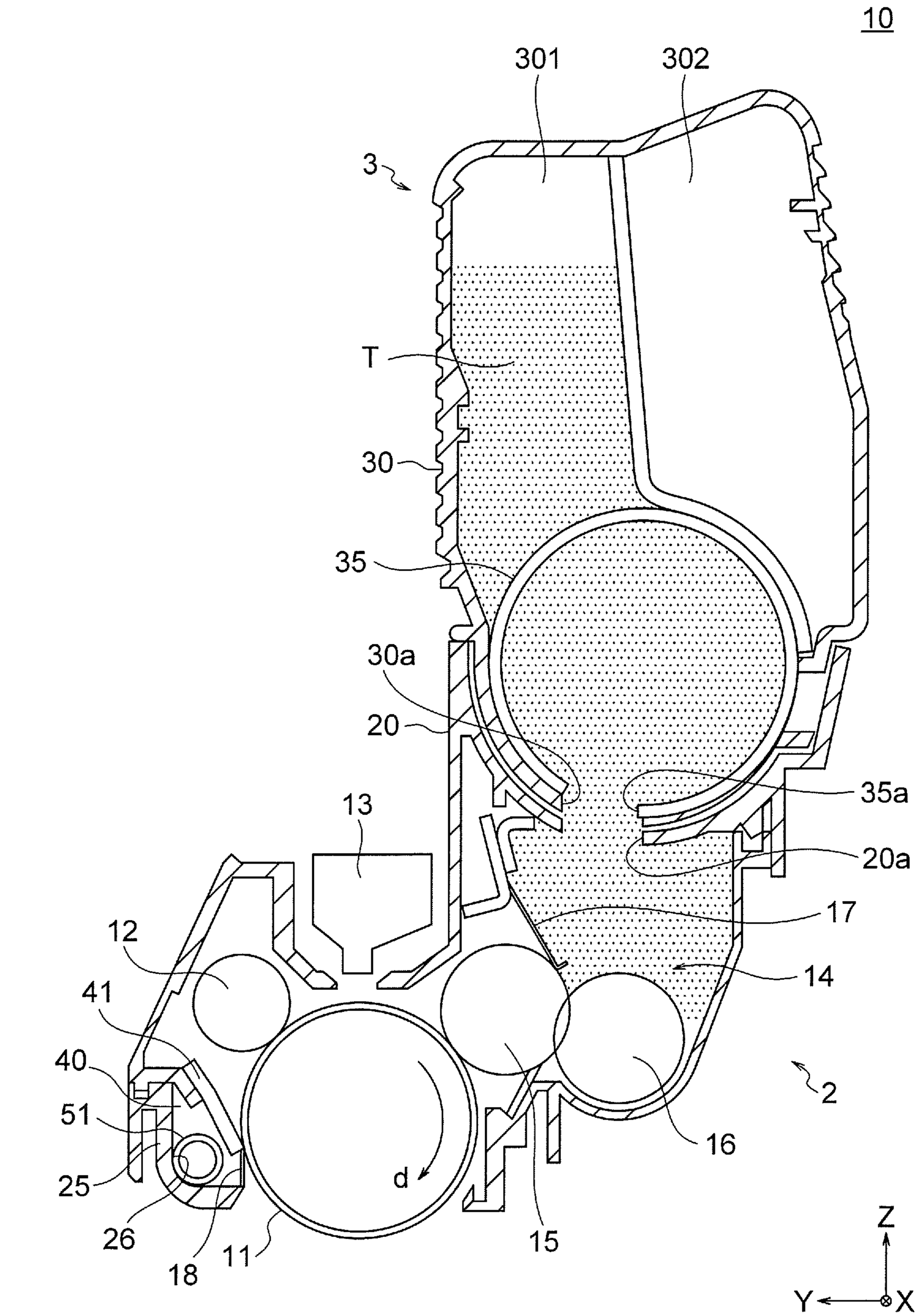
11
91
83
84
81
82
8
B
9
92
78
7B
77
75
74
7A
72
73
70
71
P
Z
X
Y

FIG. 2


10
301
302
3
T
30
35
30a
20
35a
13
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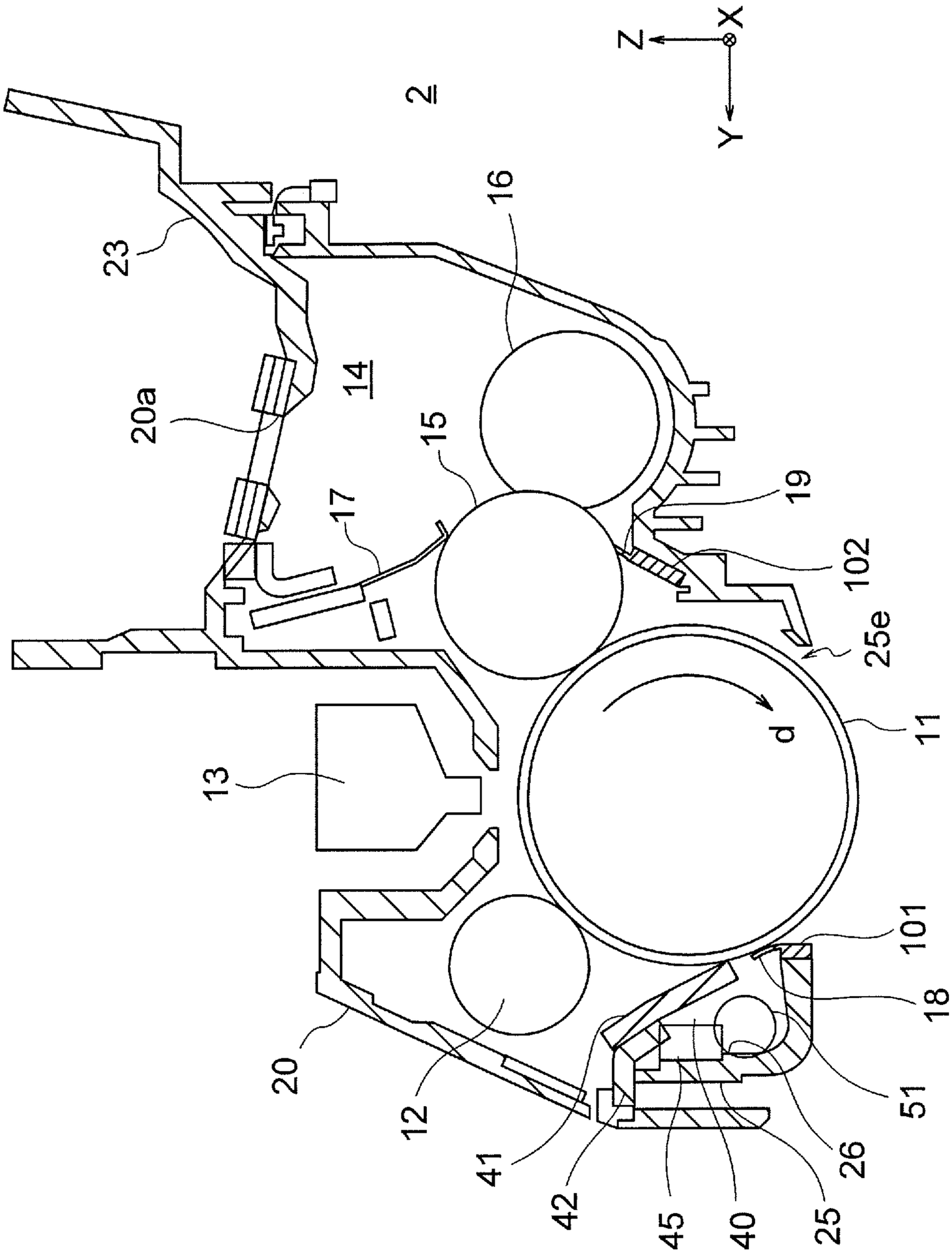
14
41
40
51
25
26
18
11
d
16
15
2
Z
Y
X

FIG. 3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2
16
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15
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25
26
51
18
101

FIG. 4

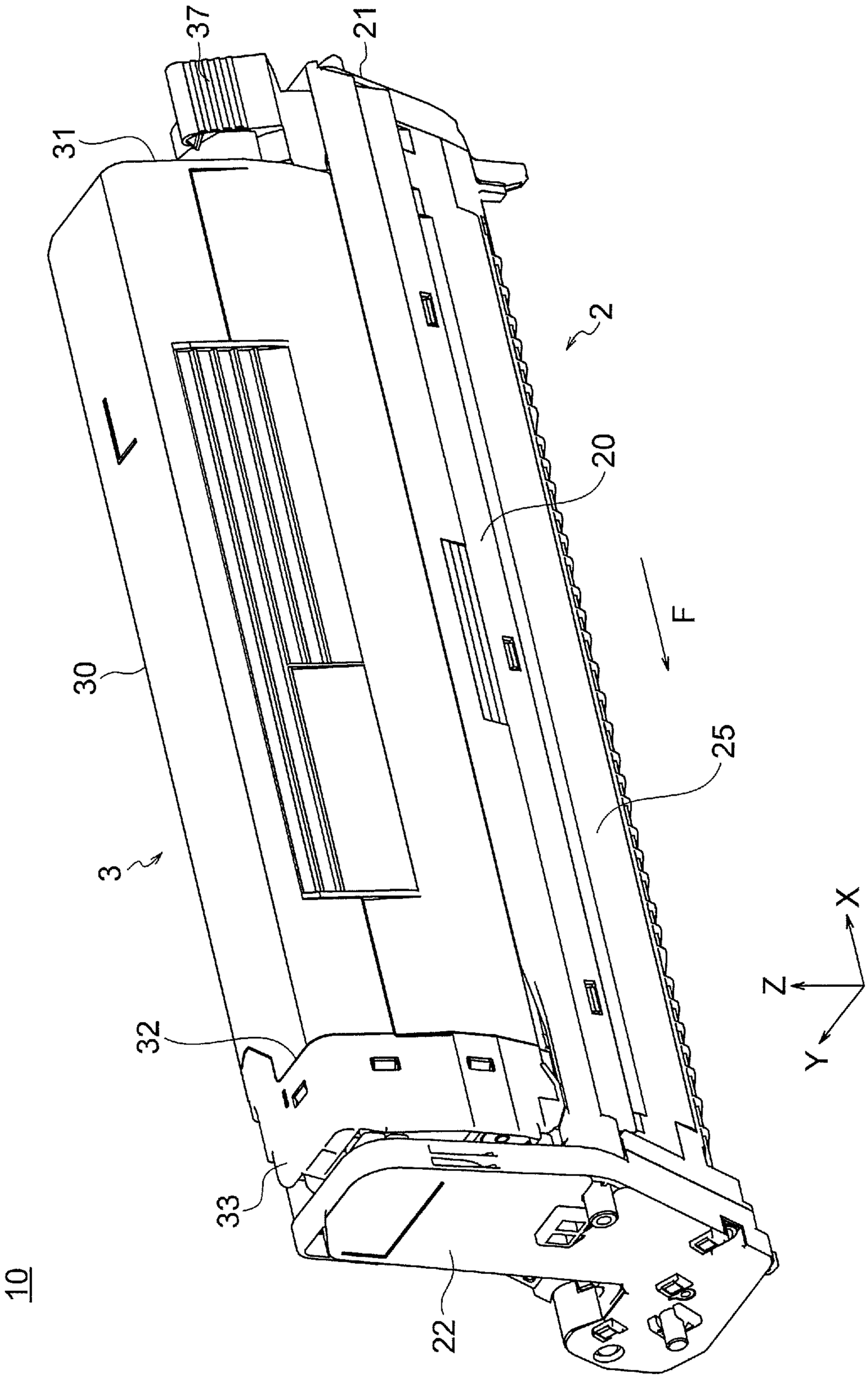


FIG. 5

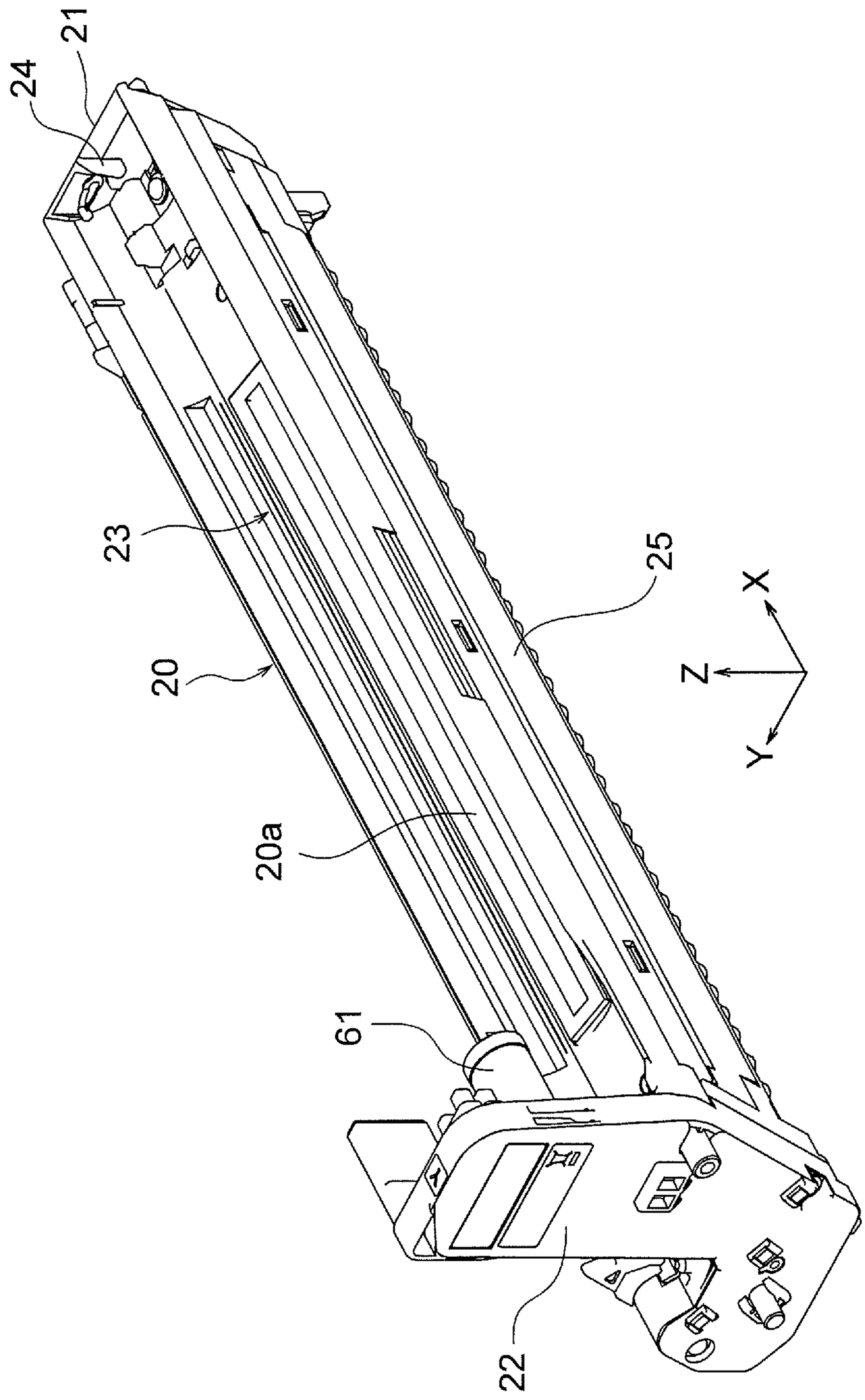


FIG. 6

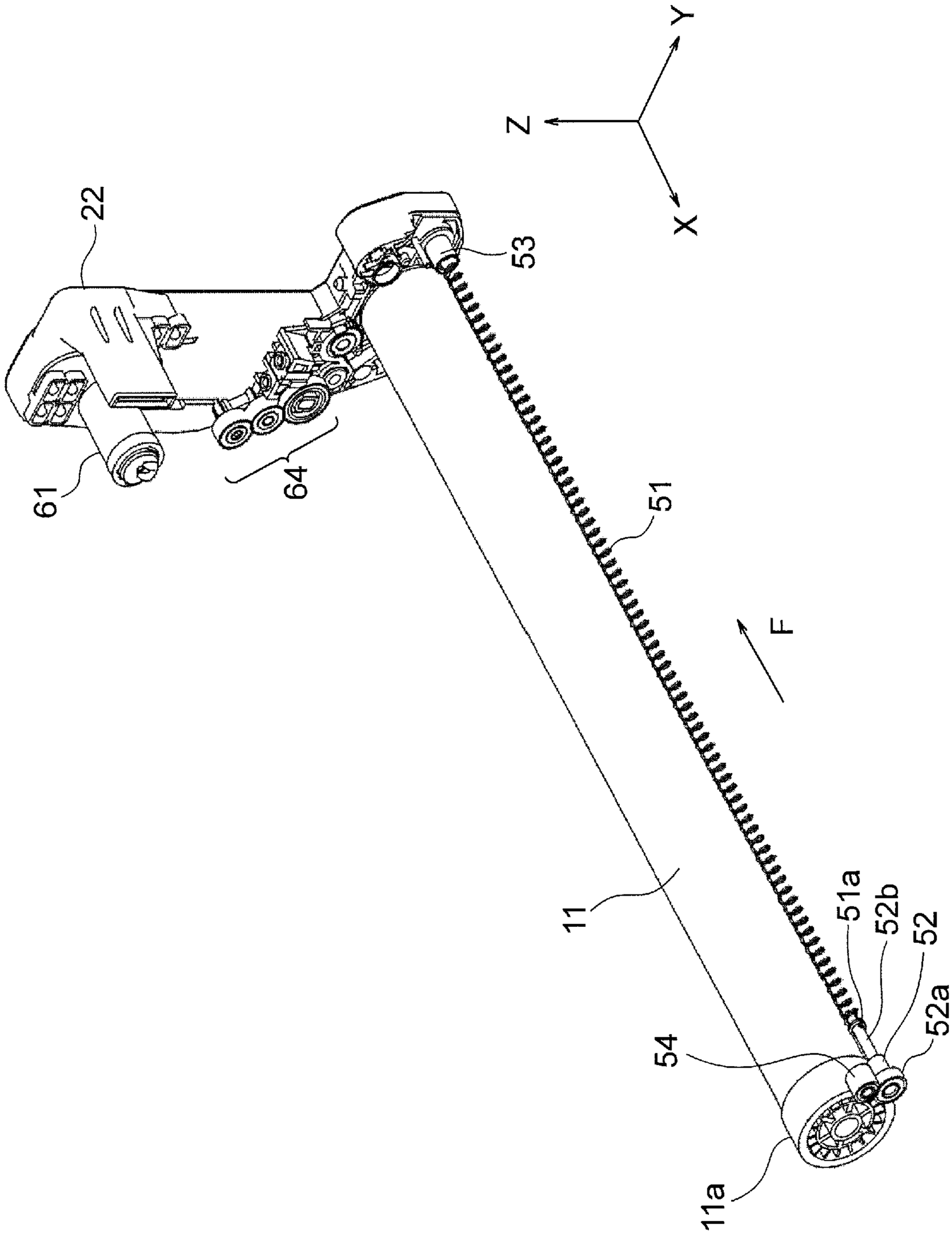


FIG. 7

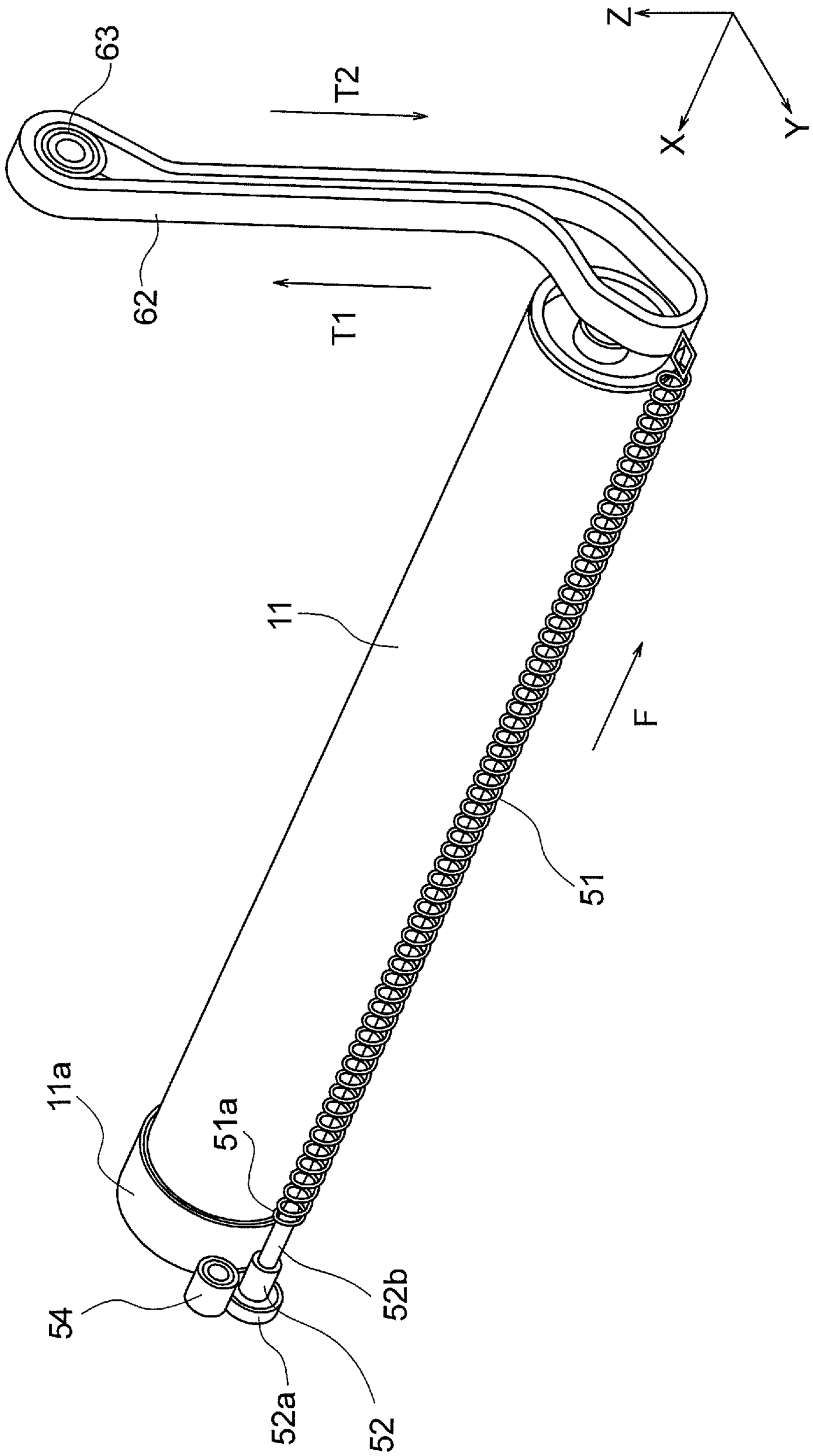


FIG. 8

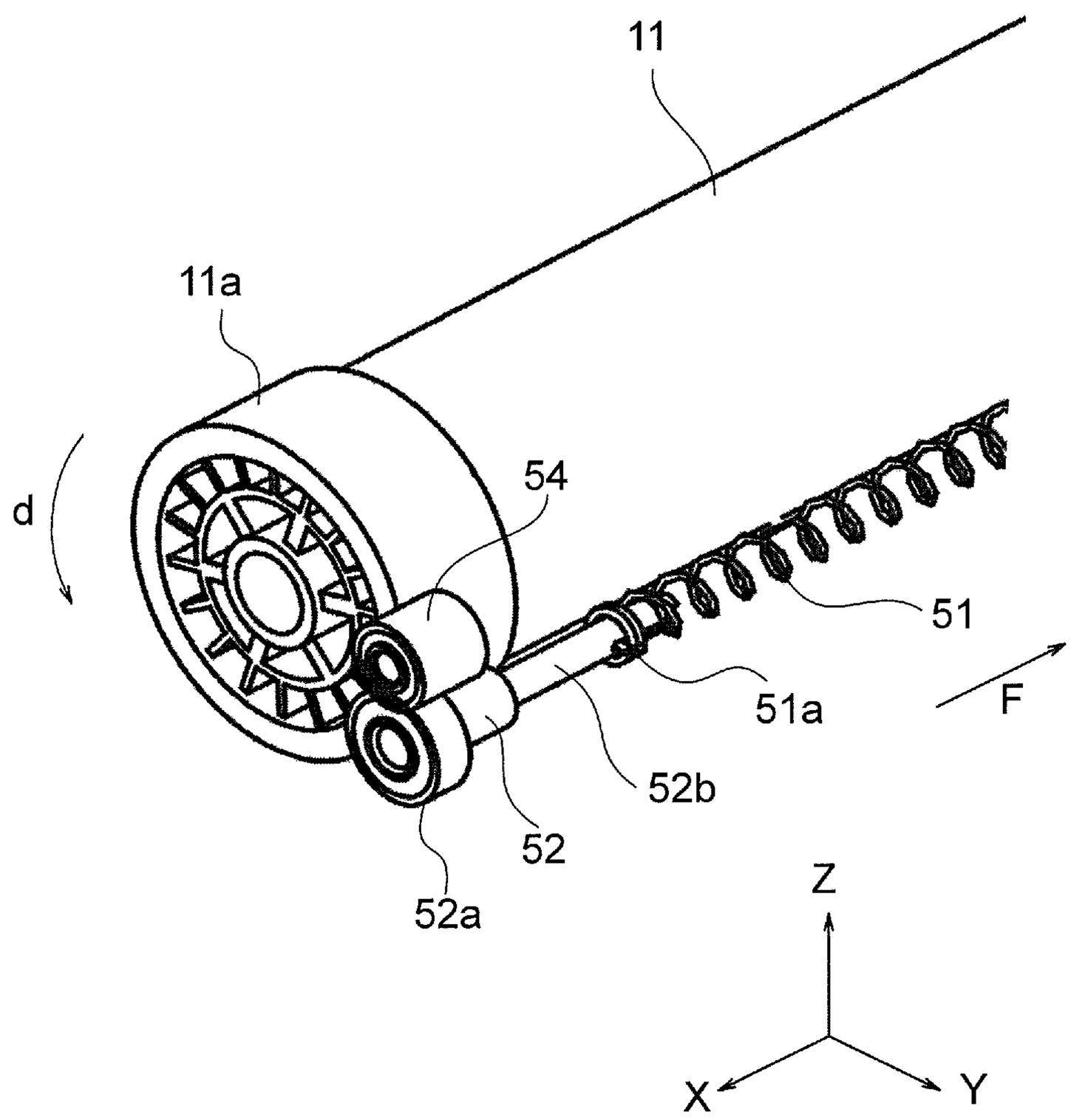


FIG. 9

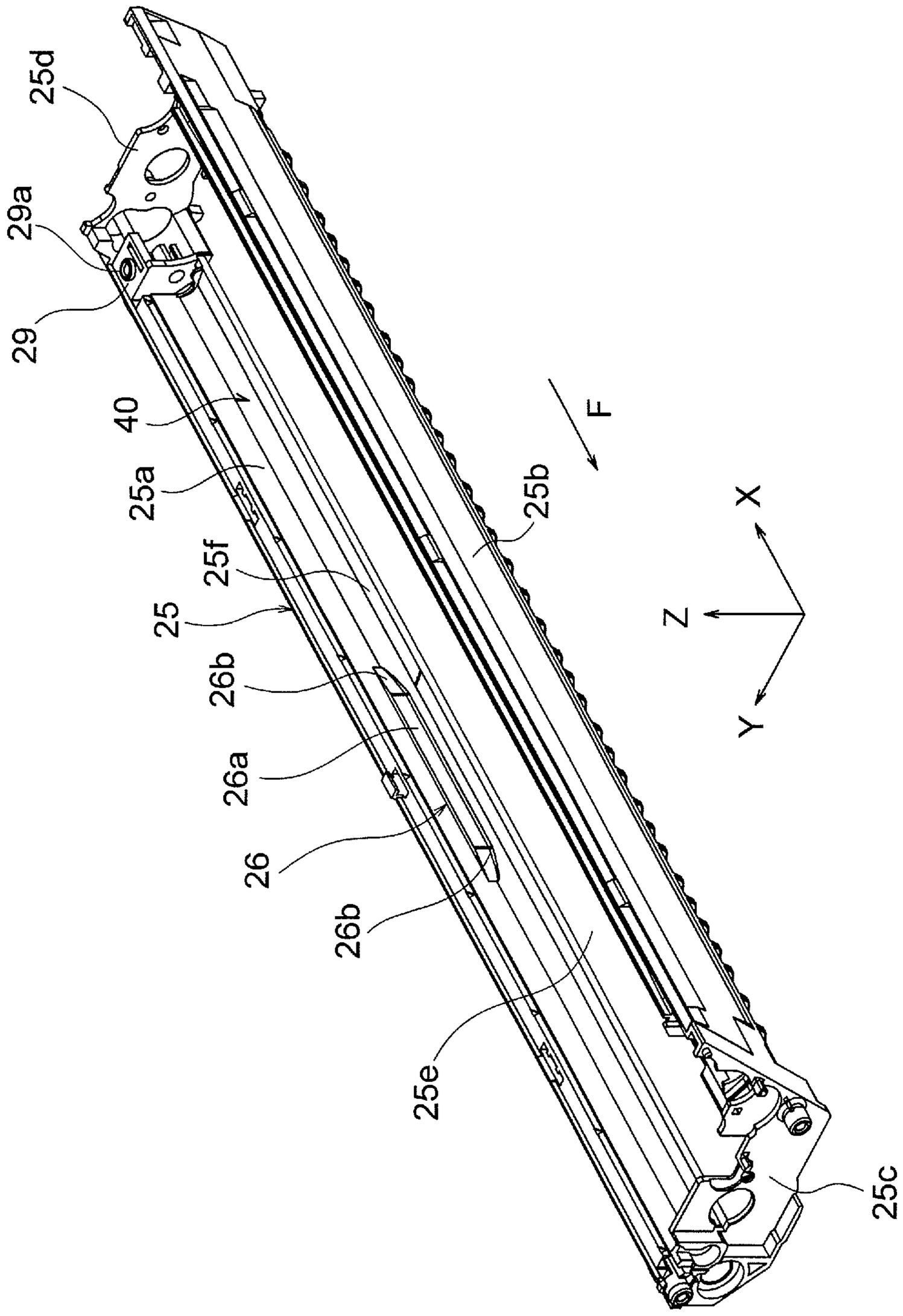
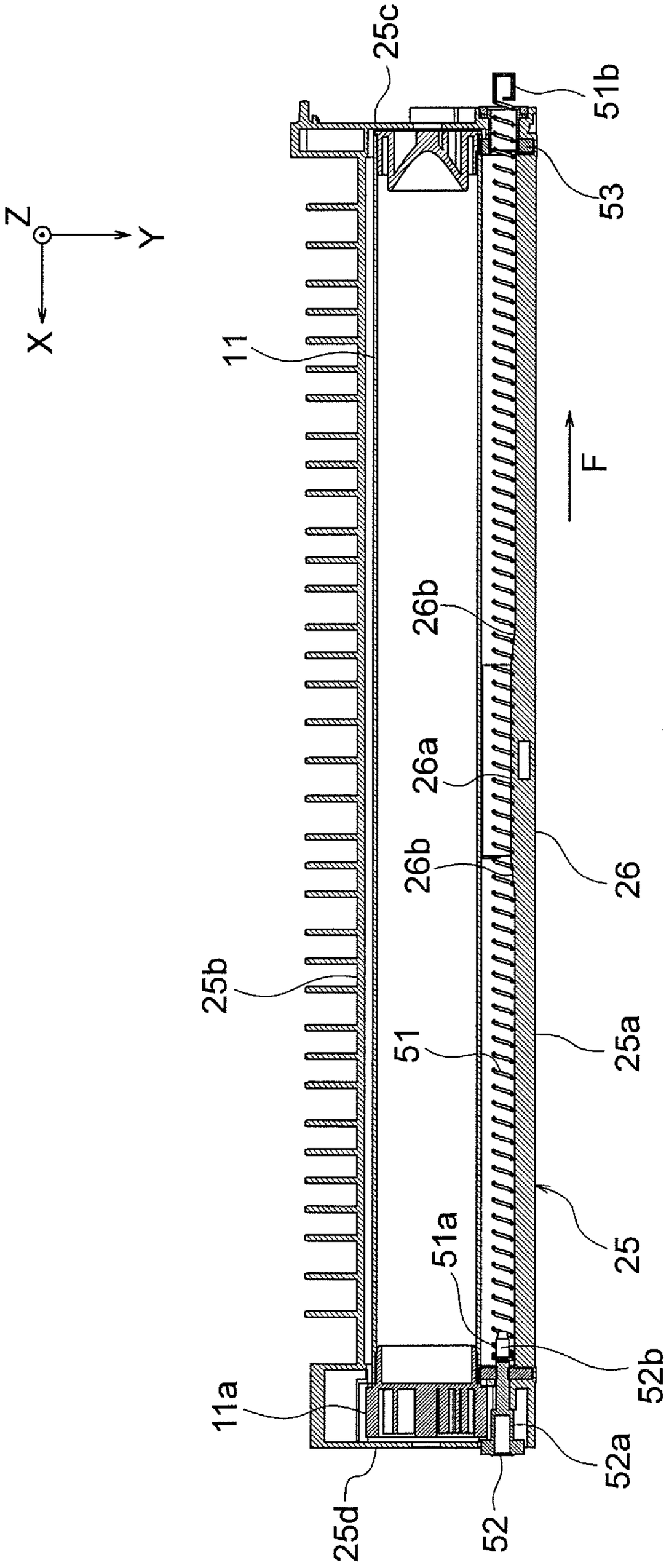


FIG. 10


Z
Y
X
25c
51b
53
11
F
26b
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26b
26
25b
51
25a
51a
25
11a
52b
52a
25d
52

FIG. 11

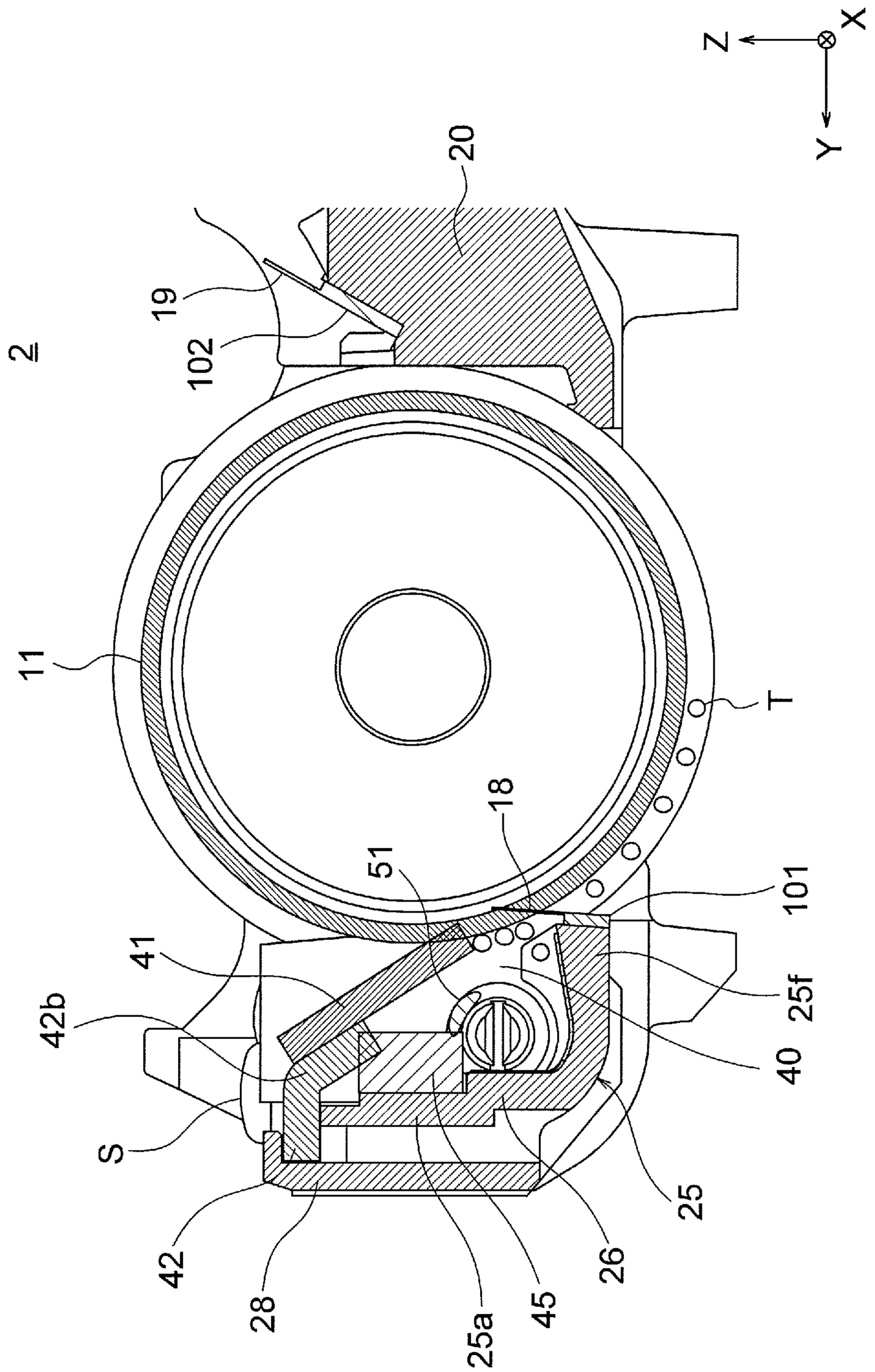

FIG. 12

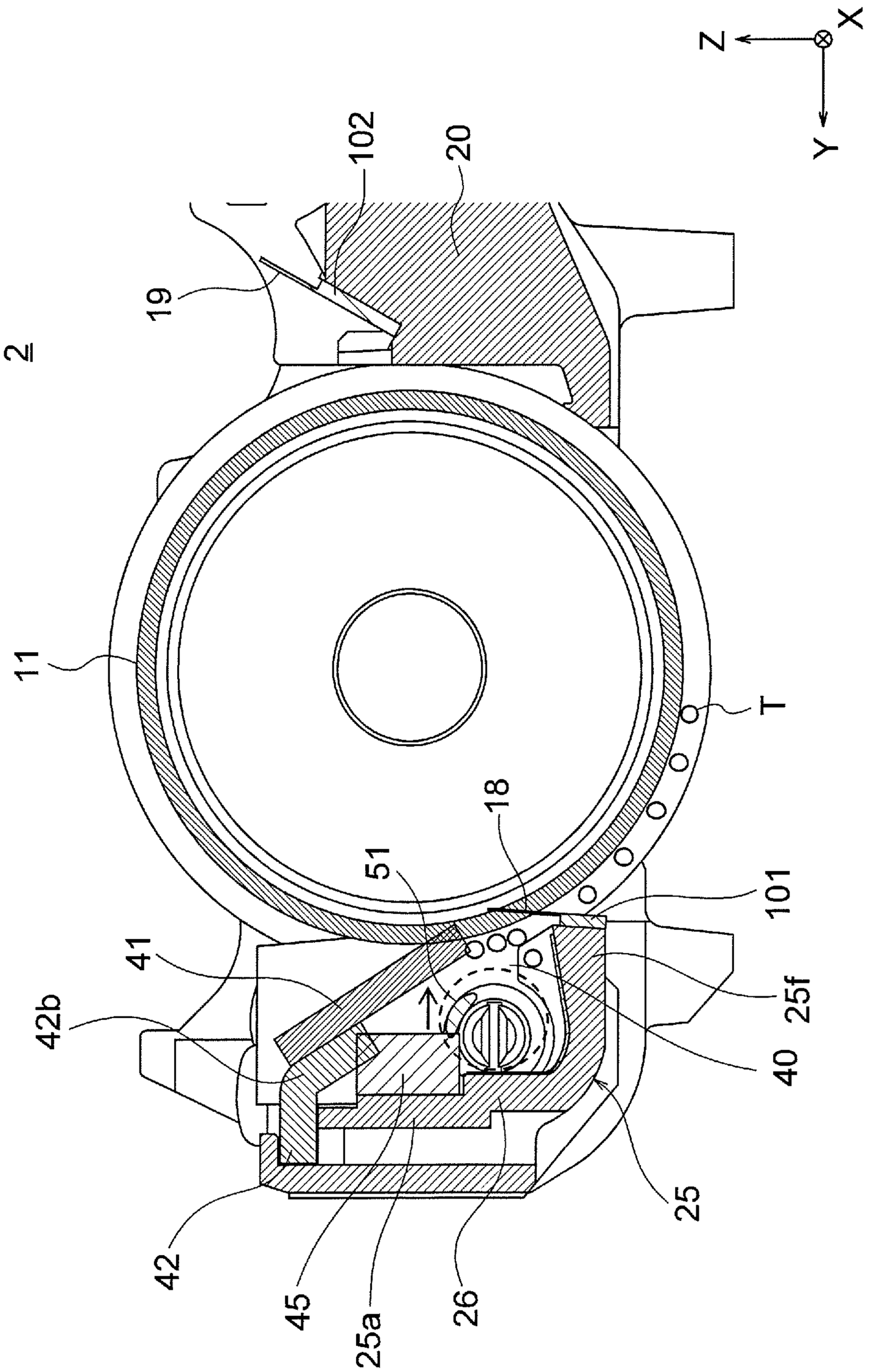

FIG. 13

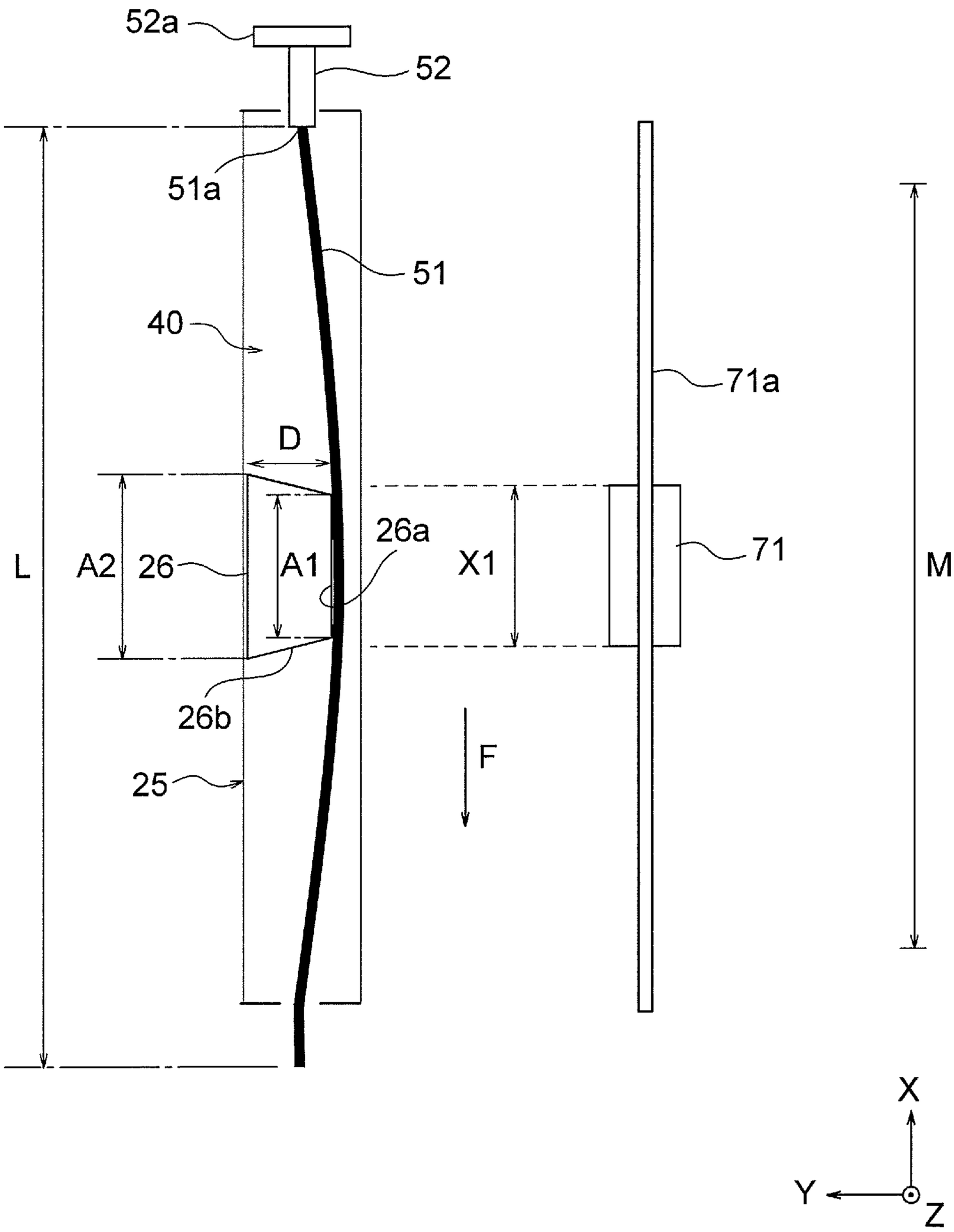

FIG. 14

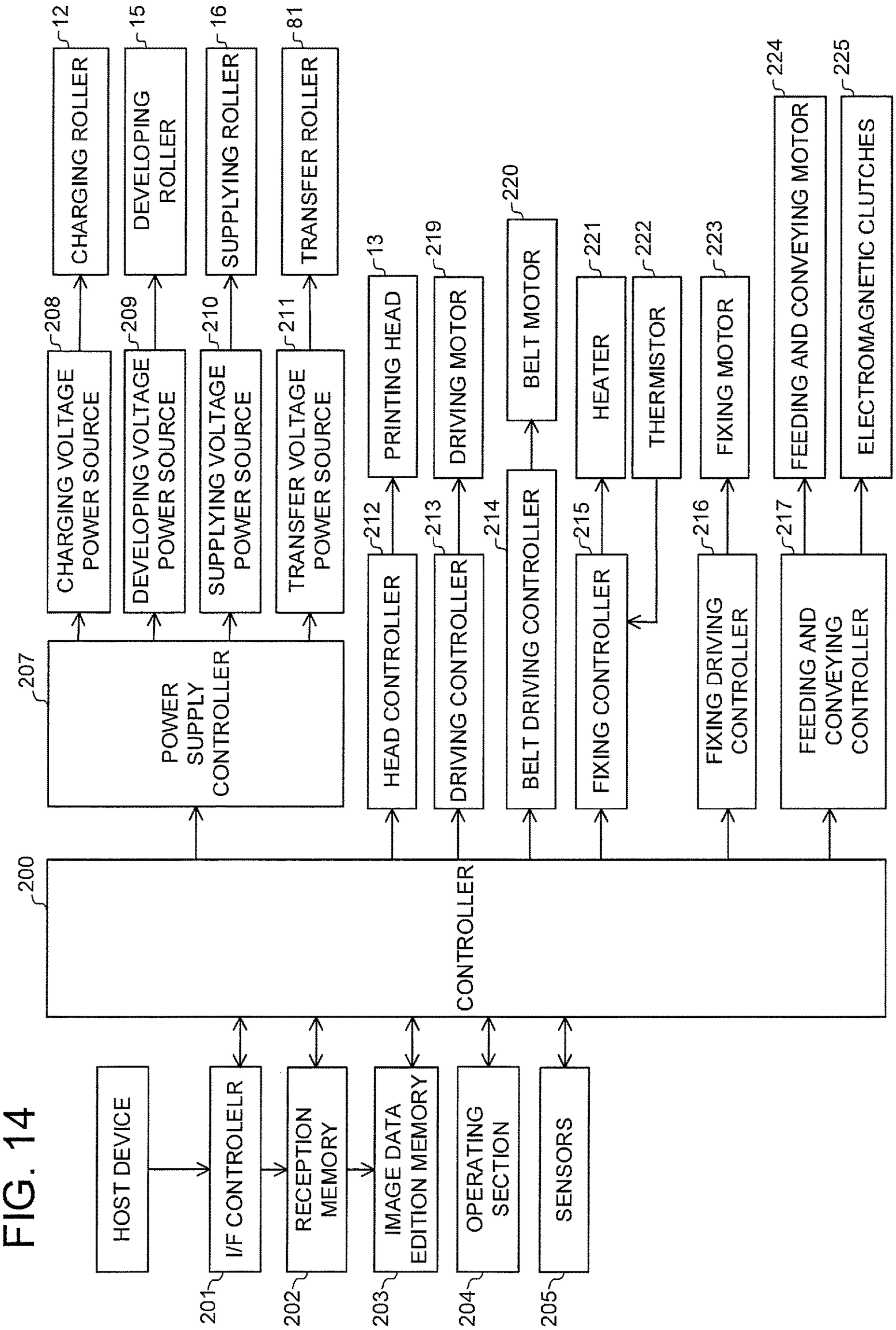
200
CONTROLLER
HOST DEVICE
I/F CONTROLELR
RECEPTION MEMORY
IMAGE DATA EDITION MEMORY
OPERATING SECTION
SENSORS
201
202
203
204
205
POWER SUPPLY CONTROLLER
207
CHARGING VOLTAGE POWER SOURCE
DEVELOPING VOLTAGE POWER SOURCE
SUPPLYING VOLTAGE POWER SOURCE
TRANSFER VOLTAGE POWER SOURCE
208
209
210
211
HEAD CONTROLLER
DRIVING CONTROLLER
BELT DRIVING CONTROLLER
FIXING CONTROLLER
FIXING DRIVING CONTROLLER
FEEDING AND CONVEYING CONTROLLER
212
213
214
215
216
217
CHARGING ROLLER
DEVELOPING ROLLER
SUPPLYING ROLLER
TRANSFER ROLLER
12
15
16
81
PRINTING HEAD
DRIVING MOTOR
BELT MOTOR
HEATER
THERMISTOR
FIXING MOTOR
FEEDING AND CONVEYING MOTOR
ELECTROMAGNETIC CLUTCHES
13
219
220
221
222
223
224
225

FIG. 15A

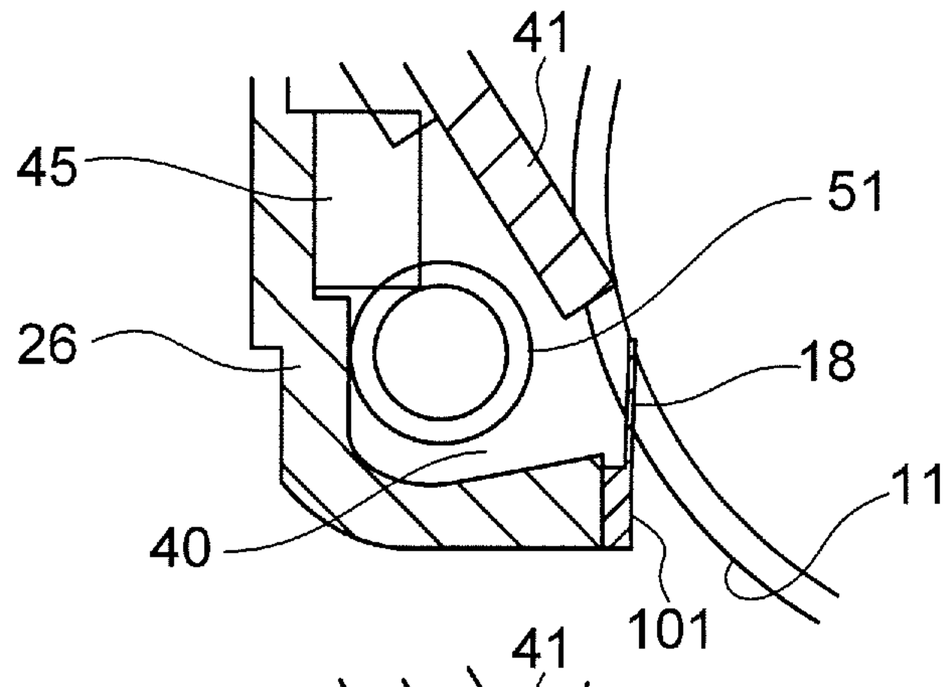

FIG. 15B

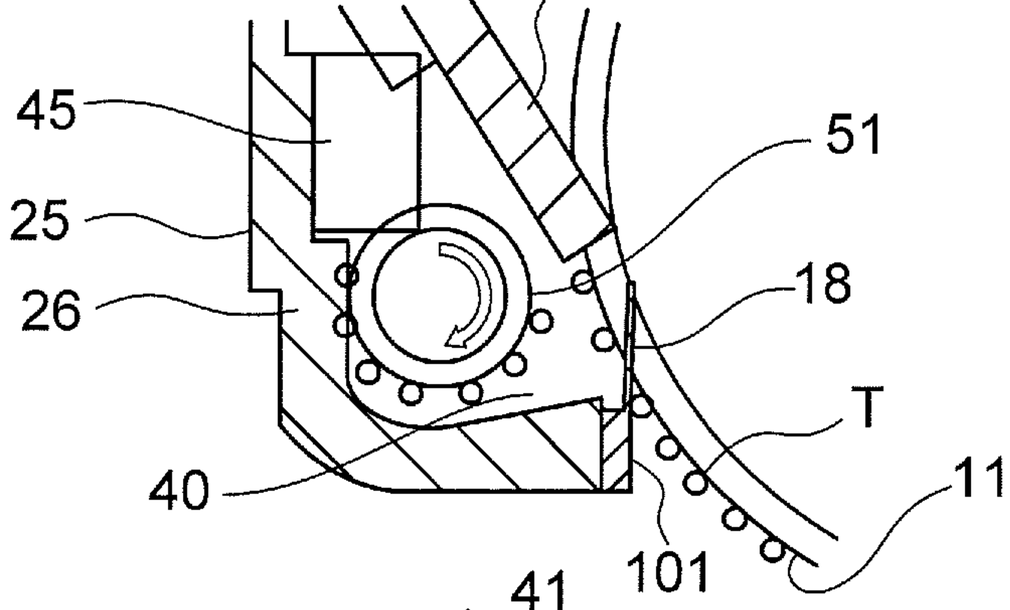

FIG. 15C

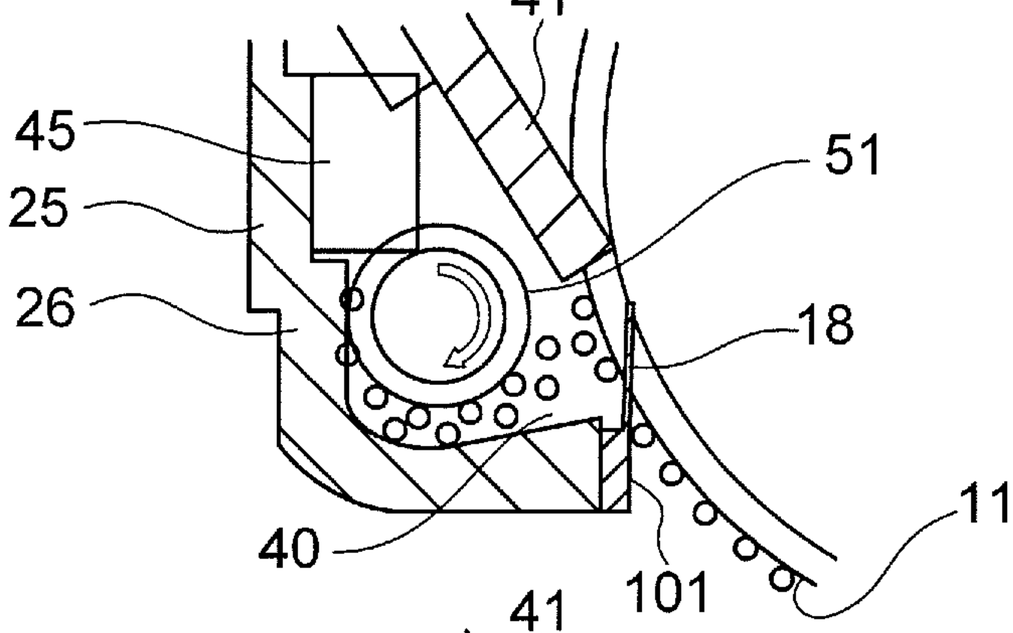

FIG. 15D

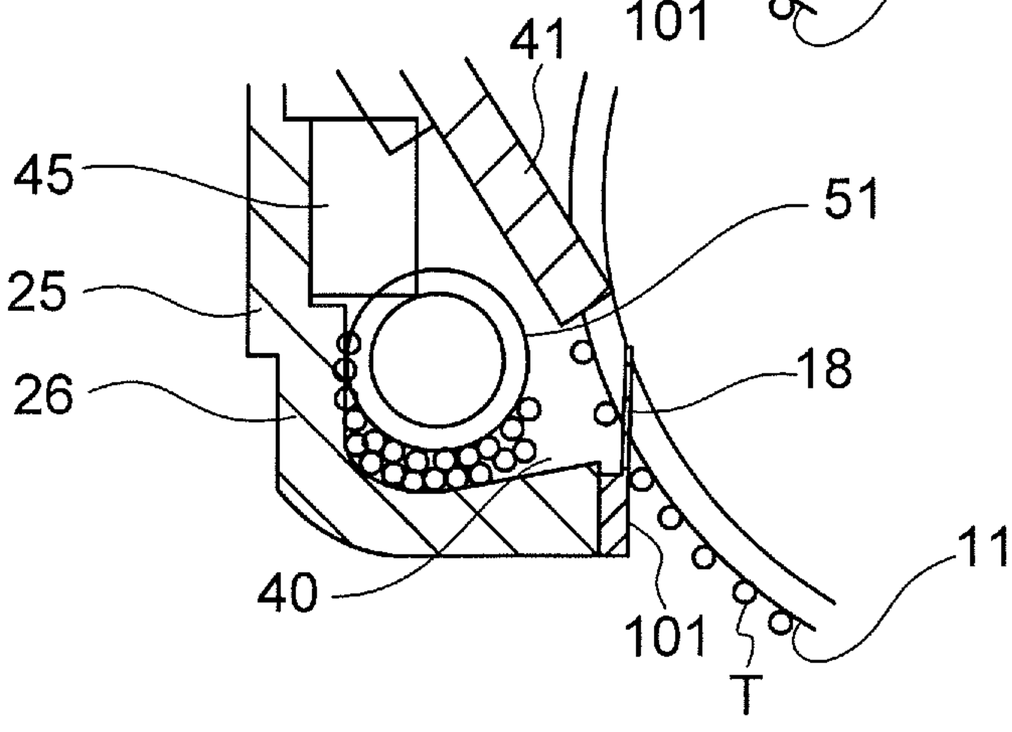

FIG. 16

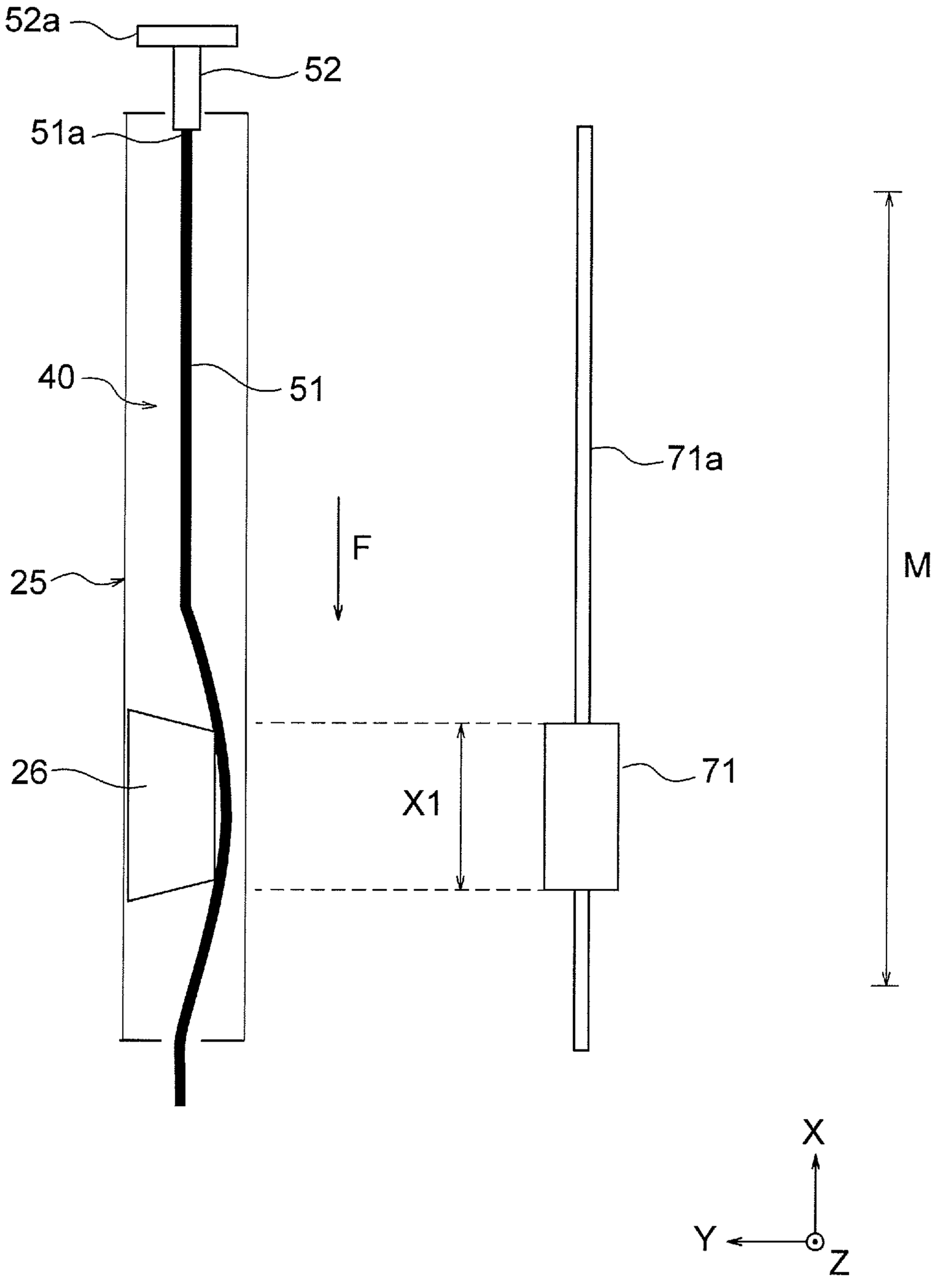

FIG. 17

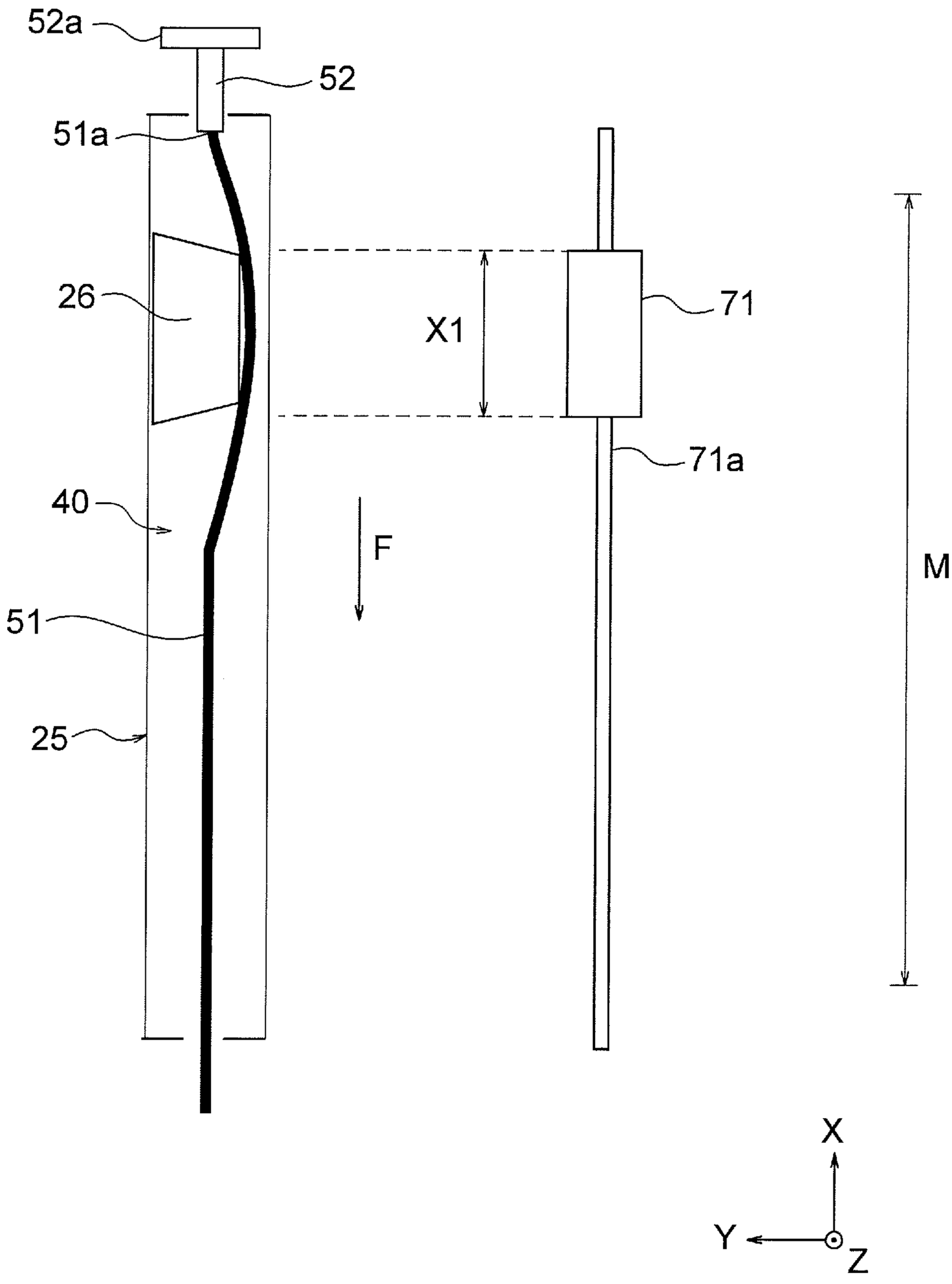

IMAGE FORMING UNIT AND IMAGE FORMING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image forming unit and an image forming apparatus that form an image using electrophotography.

2. Description of the Related Art

In an image forming unit that forms an image using electrophotography, a toner image is formed on a surface of a photosensitive drum, and is transferred to a medium such as a printing sheet. The toner remaining on a surface of the photosensitive drum after transferring is scraped by a cleaning member, and is stored in a waste toner storage section. The toner stored in the waste toner storage section is conveyed outside by a waste toner conveying member. See, for example, Japanese Patent Application Publication No. 2014-238536 (see FIG. **5**).

SUMMARY OF THE INVENTION

In this regard, there are cases where paper dust on the medium such as a printing sheet may stick to the photosensitive drum, and may be scraped together with the toner by the cleaning member. The toner mixed with the paper dust has low flowability and can hardly be conveyed by the waste toner conveying member. Such toner tends to be accumulated in the waste toner storage section. If the toner mixed with the paper dust is accumulated in the waste toner storage section, it may lead to leakage of the toner.

The present invention is intended to solve the above described problem, and an object of the present invention is to efficiently convey a developer in a developer storage section to thereby inhibit leakage of the developer.

According to an aspect of the present invention, there is provided an image forming unit including an image bearing body, a developer storage section that stores a developer removed from a surface of the image bearing body, a frame surrounding the developer storage section, a developer conveying member that conveys the developer in the developer storage section in a predetermined direction, and a convex portion that is provided in the frame and pushes the developer conveying member toward the image bearing body.

An image forming apparatus according to the present invention includes the above described image forming unit.

With such a configuration, since the developer conveying member is pushed toward the image bearing body by the convex portion, the developer whose flowability is lowered by mixture with paper dust can easily be conveyed by the developer conveying member. As a result, accumulation of the developer can be inhibited, and thus leakage of the developer can be inhibited.

BRIEF DESCRIPTION OF THE DRAWINGS

In the attached drawings:

FIG. **1** is a view illustrating an image forming apparatus according to a first embodiment;

FIG. **2** is a sectional view illustrating a process unit according to the first embodiment;

FIG. **3** is a sectional view illustrating a unit main body according to the first embodiment;

FIG. **4** is a perspective view illustrating an external appearance of the process unit according to the first embodiment;

FIG. **5** is a perspective view illustrating a housing of the unit main body according to the first embodiment;

FIG. **6** is a perspective view illustrating a photosensitive drum, a waste toner conveying spiral, and a waste toner conveying mechanism according to the first embodiment;

FIG. **7** is a perspective view illustrating the photosensitive drum, the waste toner conveying spiral, and a waste toner conveying belt according to the first embodiment;

FIG. **8** is a perspective view illustrating a rotation transmitting portion between the photosensitive drum and the waste toner conveying spiral according to the first embodiment;

FIG. **9** is a perspective view illustrating a base frame according to the first embodiment;

FIG. **10** is a sectional view illustrating the base frame according to the first embodiment;

FIG. **11** is a sectional view illustrating a portion including the photosensitive drum, a cleaning blade, and the waste toner conveying spiral of the unit main body according to the first embodiment;

FIG. **12** is another sectional view illustrating the portion including the photosensitive drum, the cleaning blade, and the waste toner conveying spiral of the unit main body according to the first embodiment;

FIG. **13** is a schematic view illustrating a positional relationship among the waste toner conveying spiral, a projecting portion, and a hopping roller according to the first embodiment;

FIG. **14** is a block diagram illustrating a control system of the image forming apparatus according to the first embodiment;

FIGS. **15**A to **15**D are schematic views illustrating a waste toner storage section and its surroundings according to the first embodiment;

FIG. **16** is a schematic view illustrating a positional relationship among a waste toner conveying spiral, a projecting portion, and a hopping roller according to a first modification of the first embodiment; and

FIG. **17** is a schematic view illustrating a positional relationship among a waste toner conveying spiral, a projecting portion, and a hopping roller according to a second modification of the first embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

First Embodiment

<Configuration of Image Forming Apparatus>

An image forming apparatus **1** according to a first embodiment will be described below. FIG. **1** is a view illustrating the image forming apparatus **1** according to the first embodiment. The image forming apparatus **1** is configured as a printer (more specifically, a color electrophotographic printer) that forms a color image using electrophotography. The image forming apparatus **1** includes a medium supplying section **7**A, an image forming section **5**, a fixing device **9**, and a medium ejection section **7**B. The medium supplying section **7**A supplies a medium P such as a printing sheet. The image forming section **5** forms a toner image (i.e., a developer image) on the medium P supplied by the medium supplying section **7**A. The fixing device **9** fixes

the toner image to the medium P. The medium ejection section **7**B ejects the medium P to which the toner image is fixed.

The medium supplying section **7**A includes a tray **70** as a medium storage section, a hopping roller **71** as a delivery member, a feeding roller **72**, a separation pad **73**, and two pairs of conveying rollers **74** and **75**. The tray **70** stores a stack of media P. The hopping roller **71** delivers the medium P stored in the tray **70**. The feeding roller **72** and the separation pad **73** separate the delivered medium P from the succeeding media P and feed the medium P to a medium conveyance path. The conveying rollers **74** and **75** convey the media P to the image forming section **5**.

The image forming section **5** includes four process units **10**K, **10**Y, **10**M, and **10**C as image forming units, and a transfer unit **8**. The process units **10**K, **10**Y, **10**M, and **10**C form toner images of black (K), yellow (Y), magenta (M), and cyan (C). The transfer unit **8** transfers the toner images to a surface of the medium P by Coulomb force.

The process units **10**K, **10**Y, **10**M, and **10**C are arranged in this order from an upstream side to a downstream side (from the right to the left in FIG. **1**) in a conveying direction of the medium P. Printing heads **13**K, **13**Y, **13**M, and **13**C as exposure devices are provided so as to face photosensitive drums **11** (described later) of the process units **10**K, **10**Y, **10**M, and **10**C.

The process units **10**K, **10**Y, **10**M, and **10**C will be referred to as process units (image forming units) **10** unless it is necessary to distinguish them. The printing heads **13**K, **13**Y, **13**M, and **13**C will be referred to as printing heads **13** unless it is necessary to distinguish them.

FIG. **2** is a sectional view illustrating an internal configuration of the process unit **10**. The process unit **10** includes a photosensitive drum **11** as an image bearing body. The photosensitive drum **11** is a cylindrical member having a photosensitive layer on its surface, and is rotated in one direction (indicated by an arrow d) by a driving motor **219** (FIG. **14**).

A charging roller **12** as a charging member, the printing head **13** as an exposure device, a developing section **14**, and a cleaning blade **41** as a cleaning member are provided around the photosensitive drum **11** in a rotating direction of the photosensitive drum **11**.

The charging roller **12** is provided in contact with the photosensitive drum **11**, and rotates to follow a rotation of the photosensitive drum **11**. The charging roller **12** is applied with a charging voltage by a charging voltage power source **208** (FIG. **14**), and uniformly charges the surface of the photosensitive drum **11**.

The printing head **13** includes, for example, a lens array, and a board on which LEDs (Light Emitting Diodes) and a driving circuit are mounted. The printing head **13** is disposed at a position where light emitted by the LEDs is focused on the surface of the photosensitive drum **11**. As the surface of the photosensitive drum **11** is exposed with light emitted by the printing head **13**, an electrical potential on the exposed portion of the photosensitive drum **11** attenuates, and an electrostatic latent image is formed.

The developing section **14** is configured to develop the electrostatic latent image using a nonmagnetic single-component toner as a developer. The developing section **14** includes a developing roller **15** as a developer bearing body, a supplying roller **16** as a supplying member, and a developing blade **17**. The developing roller **15** is provided in contact with the photosensitive drum **11**. The supplying roller **16** is provided in contact with or facing the developing roller **15**. The developing blade **17** is pressed against the developing roller **15**.

The developing roller **15** is applied with a developing voltage having the same polarity (for example, negative polarity) as a charging polarity of the photosensitive drum **11** by a developing voltage power source **209** (FIG. **14**), and causes the toner to adhere to the exposed portion of the photosensitive drum **11**. The supplying roller **16** is applied with a supplying voltage by a supplying voltage power source **210** (FIG. **14**), and supplies the toner to the developing roller **15**. The developing blade **17** regulates a thickness of a toner layer formed on a surface of the developing roller **15**.

The cleaning blade **41** removes the toner (i.e., transfer residual toner) remaining on the surface of the photosensitive drum **11** after transferring of the toner image. The cleaning blade **41** will be described in detail later.

Referring back to FIG. **1**, the transfer unit **8** includes a transfer belt **82**, four transfer rollers **81**, a driving roller **83**, and a tension roller **84**. The transfer belt **82** conveys the medium P. The transfer rollers **81** are provided facing the photosensitive drums **11** of the respective process units **10** across the transfer belt **82**. The driving roller **83** drives the transfer belt **82**. The tension roller **84** applies tension to the transfer belt **82**.

Each transfer roller **81** is applied with a voltage having a polarity opposite to a charging polarity of the toner by a transfer voltage power source **211** (FIG. **14**). With this voltage, the toner images of respective colors formed on the photosensitive drums **11** are transferred to the medium P. The driving roller **83** is rotated by a belt motor **220** (FIG. **14**) to cause the transfer belt **82** to travel in a direction indicated by an arrow B in FIG. **1**.

The fixing device **9** includes, for example, a fixing roller **91**, and a pressure roller **92** pressed against the fixing roller **91**. The fixing roller **91** has a heater **221** (FIG. **14**) as a heat source therein, and is rotated by a fixing motor **223** (FIG. **14**). The fixing roller **91** and the pressure roller **92** apply heat and pressure to the toner image transferred to the medium P to thereby fix the toner image to the medium P.

The medium ejection section **7**B includes two pairs of ejection rollers **77** and **78** that convey the medium P having passed the fixing device **9**. The medium ejection section **7**B ejects the medium P to which the toner image is fixed. The ejection rollers **77** and **78** are rotated by rotation transmitted from the fixing motor **223** (FIG. **14**). An upper cover of the image forming apparatus **1** is provided with a stacker portion **79** on which the media P ejected by the medium ejection section **7**B are stacked.

In FIG. **1**, a moving direction of the medium P when the medium P passes through the process units **10**K, **10**Y, **10**M, and **10**C is defined as a Y direction. A direction of a rotation axis of the photosensitive drum **11** is defined as an X direction. The X direction is the same as a widthwise direction of the medium P. As for the Y direction, the moving direction of the medium P passing through the process units **10**K, **10**Y, **10**M, and **10**C is defined as a +Y direction, and its opposite direction is defined as a −Y direction. A direction perpendicular to both of the X direction and the Y direction is defined as a Z direction. In this example, the Z direction is a vertical direction.

<Configuration of Process Unit>

Next, a configuration of the process unit **10** will be described. The process unit **10** includes a unit main body **2**, and a toner cartridge **3** detachably mounted on the unit main body **2**, as illustrated in FIG. **2**. The unit main body **2**

includes a main body frame **20**. The main body frame **20** houses the photosensitive drum **11**, the charging roller **12**, the developing section **14**, and the cleaning blade **41**.

The toner cartridge **3** as a developer storage body includes an outer case **30** and a shutter **35**. The shutter **35** serves as an opening and closing member, and is disposed inside the outer case **30**. The outer case **30** includes a toner storage chamber **301** and a waste toner storage chamber **302**. The toner storage chamber **301** stores an unused toner (indicated by a reference symbol T in FIG. **2**). The waste toner storage chamber **302** stores a waste toner.

The outer case **30** includes a toner supplying opening **30***a* on its bottom. The toner supplying opening **30***a* serves as an ejection portion through which the toner is ejected (i.e., supplied to the developing section **14**). The shutter **35** is disposed in the outer case **30** so as to be rotatable about a rotation axis in the X direction.

The outer case **30** is a substantially cylindrical member with an upper side opened, and includes an opening **35***a* having substantially the same shape as the toner supplying opening **30***a*. The shutter **35** includes a lever **37** (FIG. **4**) at its end in the +X direction. The shutter **35** is rotated by operation of the lever **37**.

As illustrated in FIG. **2**, when the opening **35***a* of the shutter **35** is at a position overlapping with the toner supplying opening **30***a*, the toner supplying opening **30***a* is opened. In this state, the toner is ejected from the toner supplying opening **30***a* and is supplied to the developing section **14** through a toner inlet opening **20***a* of the unit main body **2**. When the opening **35***a* of the shutter **35** is in a position shifted from the toner supplying opening **30***a*, the toner supplying opening **30***a* is closed.

FIG. **3** is a sectional view illustrating the unit main body **2**. A housing of the unit main body **2** includes a base frame **25** and a main body frame **20**. The base frame **25** surrounds the photosensitive drum **11**. The main body frame **20** covers an upper side (i.e., the +Z side) of the base frame **25**. An opening **25***e* is formed on a bottom of the base frame **25**. The photosensitive drum **11** faces the transfer belt **82** (or the medium P thereon) via the opening **25***e*.

The cleaning blade **41** is fixed to the base frame **25**. The cleaning blade **41** is made of a resilient member such as urethane rubber. The cleaning blade **41** is elongated in the X direction, and has a rectangular cross-section in the YZ plane.

A length of the cleaning blade **41** in the X direction is substantially the same as that of the photosensitive drum **11**.

A metal blade holder **42** for holding the cleaning blade **41** is fixed to the base frame **25**. The cleaning blade **41** is fixed to the blade holder **42** so that one end of the cleaning blade **41** in the widthwise direction thereof contacts the surface of the photosensitive drum **11**. The cleaning blade **41** scrapes the transfer residual toner from the surface of the photosensitive drum **11**.

In the base frame **25**, a waste toner storage section **40** as a developer storage section is provided below the cleaning blade **41**. The waste toner storage section **40** stores the toner (i.e., the waste toner) scraped from the photosensitive drum **11**. The waste toner storage section **40** extends over an entire region of the photosensitive drum **11** in the X direction. A waste toner conveying spiral **51** as a developer conveying member is provided in the waste toner storage section **40**. The waste toner conveying spiral **51** conveys the waste toner in the X direction.

A sponge member **45** is disposed in the waste toner storage section **40** so that the sponge member **45** contacts an upper side (i.e., the +Z side) of the waste toner conveying spiral **51**. The sponge member **45** is provided between the waste toner conveying spiral **51** and the blade holder **42**. The sponge member **45** is provided for limiting a capacity of the waste toner storage section **40** so as to enhance conveyance efficiency of the waste toner conveying spiral **51**.

A seal member **18** is fixed to the base frame **25**. The seal member **18** closes a gap between the photosensitive drum **11** and the base frame **25**. The seal member **18** is elongated in the X direction, and is fixed by a seal fixing member **101** to an end surface of the opening **25***e* of the base frame **25**. The seal member **18** is flexible so as to allow passage of the toner adhering to the surface of the photosensitive drum **11**. The seal fixing member **101** may be implemented as, for example, a double-sided adhesive tape.

A seal member **19** is fixed to the base frame **25**. The seal member **19** closes a gap between the developing roller **15** and the base frame **25**. The seal member **18** is elongated in the X direction, and is fixed to a bottom of the base frame **25** by a seal fixing member **102**. The seal member **19** is flexible so as to allow passage of the toner adhering to the surface of the developing roller **15**. The seal fixing member **102** may be implemented as, for example, a double-sided adhesive tape.

FIG. **4** is a perspective view illustrating an external appearance of the process unit **10**. The toner cartridge **3** is mounted on an upper side (i.e., the +Z side) of the unit main body **2**. The outer case **30** of the toner cartridge **3** is elongated in the X direction. The outer case **30** includes a side plate **31** at its end in the +X direction and a side plate **32** at its end in the −X direction. A side cover **33** is mounted on the side plate **32**.

FIG. **5** is a perspective view illustrating a housing of the unit main body **2**. The housing of the unit main body **2** includes the base frame **25**, the main body frame **20**, and a side frame **22**. The main body frame **20** is disposed on the upper side (i.e., the +Z side) the base frame **25**. The side frame **22** is disposed at an end of the base frame **25** in the −X direction. The main body frame **20** includes a side plate portion **21** at its end in the +X direction (i.e., an end of the main body frame **20** opposite to the side frame **22**).

A cartridge mounting section **23** for mounting the toner cartridge **3** is formed on the main body frame **20**. The cartridge mounting section **23** includes a concave shaped portion along a bottom of the toner cartridge **3** (i.e., a bottom of the outer case **30**).

A toner inlet opening **20***a* is formed in the cartridge mounting section **23**. The toner inlet opening **20***a* receives the toner ejected from the toner supplying opening **30***a* of the toner cartridge **3**. A rib **24** or the like for locking the toner cartridge **3** is formed on the cartridge mounting section **23**, but a detailed description thereof is omitted. The base frame **25** will be described in detail later.

FIG. **6** is a perspective view illustrating a configuration for conveying and collecting the toner (i.e., the waste toner) scraped from the surface of the photosensitive drum **11**. The toner scraped from the photosensitive drum **11** by the cleaning blade **41** (FIG. **3**) falls and is stored in the waste toner storage section **40** (FIG. **3**).

The waste toner conveying spiral **51** is rotatably provided in the waste toner storage section **40**. The waste toner conveying spiral **51** extends in the X direction along the surface of the photosensitive drum **11**. The waste toner conveying spiral **51** rotates about a rotation axis in the X direction, and conveys the waste toner in a conveying direction (in this case, the −X direction) indicated by an arrow F.

The waste toner conveying spiral **51** is formed by spirally winding a wire made of metal such as stainless steel. A diameter of the wire is, for example, 0.8 mm. An outer diameter of the winding is, for example, 6 mm. A winding pitch is, for example, 5 mm.

A spiral holder **52** is mounted at an end **51***a* of the waste toner conveying spiral **51** in the +X direction. The spiral holder **52** includes a gear portion **52***a* and a shaft portion **52***b*. The gear portion **52***a* receives rotation transmitted from the photosensitive drum **11**. The shaft portion **52***b* is fitted into an inner circumference of the waste toner conveying spiral **51**. The spiral holder **52** is rotatably supported by the base frame **25** (FIG. **3**).

An end of the waste toner conveying spiral **51** in the −X direction is inserted into a cylindrical portion **53** provided on the side frame **22**, and is rotatably held in the cylindrical portion **53**. The cylindrical portion **53** also functions as a path allowing passage of the waste toner conveyed by the waste toner conveying spiral **51** and guiding the waste toner to a waste toner conveying belt **62** (FIG. **7**) in the side frame **22**.

A substantially cylindrical waste toner supplying section **61** is formed on an upper portion of the side frame **22**. The waste toner supplying section **61** is inserted into the waste toner storage chamber **302** (FIG. **2**) of the toner cartridge **3** mounted on the unit main body **2**.

FIG. **7** is a schematic view illustrating the waste toner conveying belt **62** (disposed in the side frame **22**) together with the photosensitive drum **11** and the waste toner conveying spiral **51**. The waste toner conveying belt **62** as a conveying member is disposed in the side frame **22** (FIG. **6**). The waste toner conveying belt **62** conveys the waste toner (having been conveyed by the waste toner conveying spiral **51**) to the waste toner supplying section **61**.

The waste toner conveying belt **62** is held by a plurality of holding portions including a pulley **63** (only the pulley **63** is illustrated in FIG. **7**), and is able to circulate in directions indicated by arrows T1 and T2 (i.e., the +Z direction and the −Z direction). The holding portions are provided on an inner circumferential side of the waste toner conveying belt **62**. The pulley **63** is rotated by rotation transmitted from the photosensitive drum **11** by a gear train **64** (FIG. **6**) provided in the side frame **22**.

When the pulley **63** rotates, the waste toner conveying belt **62** moves and conveys the waste toner in the direction (+Z direction) indicated by the arrow T1. The waste toner conveyed by the waste toner conveying belt **62** is stored in the waste toner storage chamber **302** (FIG. **2**) of the toner cartridge **3** through the waste toner supplying section **61**. FIG. **8** is a view illustrating ends of the photosensitive drum **11** and the waste toner conveying spiral **51** in the +X direction. A drum gear **11***a* for receiving rotation transmitted from the driving motor **219** is formed at the end of the photosensitive drum **11** in the +X direction.

The drum gear **11***a* meshes with a transmission gear **54** (i.e., a rotation transmitting member) supported by the base frame **25**. The transmission gear **54** meshes with the gear portion **52***a* of the spiral holder **52**. When the photosensitive drum **11** rotates in the direction indicated by the arrow d, the spiral holder **52** rotates in the same direction by meshing between the drum gear **11***a*, the transmission gear **54**, and the gear portion **52***a*.

The end **51***a* of the waste toner conveying spiral **51** is fixed to the spiral holder **52**. Therefore, the waste toner conveying spiral **51** rotates together with the spiral holder **52**, and conveys the waste toner in the conveying direction indicated by the arrow F.

FIG. **9** is a perspective view illustrating the base frame **25**. The base frame **25** is made of, for example, resin such as modified polyphenylene ether (PPE/PS). The base frame **25** includes a first wall portion **25***a*, a second wall portion **25***b*, and side wall portions **25***c* and **25***d*. The first wall portion **25***a* is located at an end of the base frame **25** in the +Y direction. The second wall portion **25***b* is located at an end of the base frame **25** in the −Y direction. The side wall portions **25***c* and **25***d* are located at both ends of the base frame **25** in the X direction. The photosensitive drum **11** (FIG. **8**) is housed in a space surrounded by the wall portions **25***a*, **25***b*, **25***c* and **25***d*.

A bottom plate portion **25***f* is formed on a lower side (on the −Z side) of the first wall portion **25***a*. A space surrounded by the first wall portion **25***a*, the bottom plate portion **25***f*, and the surface of the photosensitive drum **11** constitute a waste toner storage section **40**. The opening **25***e* through which the photosensitive drum **11** faces the transfer belt **82** (or the medium P) is formed on the bottom of the base frame **25**.

A mounting section **29** for mounting the blade holder **42** (FIG. **3**) holding the cleaning blade **41** is formed at an end of the first wall portion **25***a* in the +X direction. The mounting section **29** includes a threaded hole **29***a*, and the blade holder is fixed to the mounting section **29** using a screw.

Although not illustrated in FIG. **9**, a similar mounting section **29** is formed at an end of the first wall portion **25***a* in the −X direction.

A projecting portion **26** serving as a convex portion is formed at a central portion of the first wall portion **25***a* in the X direction. The projecting portion **26** projects from the first wall portion **25***a* in the −Y direction, that is, toward the photosensitive drum **11**.

FIG. **10** is a sectional view illustrating the unit main body **2**, taken along a plane parallel to the XY plane and passing through the rotation axis of the photosensitive drum **11**. The waste toner conveying spiral **51** extends in the X direction along the first wall portion **25***a*. The projecting portion **26** of the first wall portion **25***a* projects in the −Y direction, and pushes the central portion of the waste toner conveying spiral **51** (in the X direction) toward the photosensitive drum **11**.

The projecting portion **26** includes a central portion **26***a* extending parallel to the X direction, and inclined portions **26***b* on both sides of the central portion **26***a* in the X direction. With this configuration, the projecting portion **26** allows the waste toner conveying spiral **51** to smoothly curve in an arcuate shape so as to reduce rotational load of the waste toner conveying spiral **51**.

FIGS. **11** and **12** are sectional views taken along a plane parallel to the YZ plane and illustrating a portion including the photosensitive drum **11**, the cleaning blade **41**, and the waste toner conveying spiral **51** of the unit main body **2**. Although the cleaning blade **41** and the seal member **18** are illustrated as being straight in FIGS. **11** and **12**, they are curved by being in contact with the surface of the photosensitive drum **11**.

As illustrated in FIG. **11**, an area surrounded by the first wall portion **25***a* and the bottom plate portion **25***f* of the base frame **25**, and the surfaces of the cleaning blade **41** and the photosensitive drum **11** constitutes the waste toner storage section **40**. The waste toner storage section **40** will also be referred to as a waste toner conveyance path (i.e., a developer conveyance path).

The transfer residual toner T adhering to the surface of the photosensitive drum **11** passes the seal member **18** and

reaches the cleaning blade **41**, is scraped by the cleaning blade **41**, and is stored in the waste toner storage section **40**. The transfer residual toner T is conveyed through the waste toner storage section **40** by the waste toner conveying spiral **51** rotating together with the photosensitive drum **11**.

The projecting portion **26** of the base frame **25** pushes the central portion of the waste toner conveying spiral **51** toward the photosensitive drum **11** as illustrated in FIG. **12**. In the portion where the waste toner conveying spiral **51** is pushed, a distance to the photosensitive drum **11** is reduced, and thus a space around the waste toner conveying spiral **51** becomes narrow. In this portion, therefore, the waste toner can easily be conveyed.

FIG. **13** is a schematic view illustrating a positional relationship among the waste toner conveying spiral **51**, the projecting portion **26**, and the hopping roller **71**. The hopping roller **71** is fixed to a roller shaft **71***a* and disposed at a central portion in the X direction of a medium conveyance path M in the image forming apparatus **1**.

More specifically, both of the waste toner conveying spiral **51** and the hopping roller **71** are is disposed at the central portion of the medium conveyance path M in the X direction. In other words, a position of the projecting portion **26** in the X direction overlaps with a position of the hopping roller **71** in the X direction, as indicated by an arrow X1.

In this example, the position of the projecting portion **26** in the X direction and the position of the hopping roller **71** in the X direction fully overlap with each other, but it is sufficient that these positions at least partially overlap with each other.

When the hopping roller **71** delivers the medium P, paper dust sticks to the central portion of the medium P in the X direction due to contact between the hopping roller **71** and the medium P, or contact between the medium P and the feeding roller **72** or the separation pad **73** (FIG. **1**).

The paper dust sticking to the medium P is transferred from the medium P to the photosensitive drum **11** when the toner image on the photosensitive drum **11** is transferred to the medium P. Therefore, the toner mixed with the paper dust is scraped by the cleaning blade **41** and falls in the central portion of the waste toner storage section **40** in the X direction.

The waste toner mixed with paper dust has lower flowability than the waste toner mixed with no paper dust. Therefore, the waste toner mixed with the paper dust can hardly be conveyed by the waste toner conveying spiral **51**, and may be accumulated at the central portion of the waste toner storage section **40** in the X direction. If the waste toner mixed with the paper dust is accumulated at the central portion of the waste toner storage section **40** in the X direction, the accumulated waste toner may form a wall (bank) and hamper conveyance of other waste toner.

For this reason, in the first embodiment, the projecting portion **26** is provided at the central portion of the waste toner storage section **40** in the X direction so as to push the waste toner conveying spiral **51** toward the photosensitive drum **11**. Since the waste toner conveying spiral **51** pushed by the projecting portion **26** curves in an arcuate shape toward the photosensitive drum **11**, the space around the waste toner conveying spiral **51** is narrow at the central portion of the waste toner storage section **40** in the X direction.

Thus, the waste toner whose flowability is lowered by mixture with paper dust can easily be conveyed by the waste toner conveying spiral **51**, and is not accumulated at the central portion of the waste toner storage section **40** in the X direction. Thus, the waste toner mixed with the paper dust can be efficiently conveyed by the waste toner conveying spiral **51**. This inhibits leakage of the waste toner from the waste toner storage section **40**.

Since the waste toner conveying spiral **51** is pushed by the projecting portion **26** and is curved, a curved state of the waste toner conveying spiral **51** is constant regardless of an operation state of the image forming apparatus **1**. Thus, the waste toner conveying spiral **51** maintains a constant conveyance capability.

The waste toner conveying spiral **51** rotates in contact with the projecting portion **26**. However, since the waste toner conveying spiral **51** is made of a metal such as stainless steel, and the projecting portion **26** (as a part of the base frame **25**) is made of resin such as PPE/PS, wear of the waste toner conveying spiral **51** and the projecting portion **26** is at a negligible level.

In this regard, if the waste toner conveying spiral **51** is disposed closer to the photosensitive drum **11** as a whole, a capacity (volume) of the waste toner storage section **40** decreases, and thus the waste toner conveyance capability may decrease. In this embodiment, the waste toner conveying spiral **51** is disposed closer to the photosensitive drum **11** only at a portion where the waste toner mixed with paper dust exists. Therefore, the waste toner whose flowability is lowered by mixture with paper dust can be prevented from being accumulated, and decrease in the waste toner conveyance capability can be inhibited.

In FIG. **13**, exemplary dimensions of the projecting portion **26** are as follows. Assuming that an entire length L of the waste toner conveying spiral **51** in the X direction is 316.5 mm, a length A1 of a tip portion (i.e., the central portion **26***a*) of the projecting portion **26** in the X direction is, for example, 50.5 mm, and a length A2 of a root portion of the projecting portion **26** in the X direction is, for example, 71.1 mm. A projecting amount D of the projecting portion **26** is, for example, 1.1 mm. In order to enhance conveyance efficiency by moderately curving the waste toner conveying spiral **51** in an arcuate shape, the projecting amount D of the projecting portion **26** is desirably in a range of 0.3 to 1.1 mm.

In the foregoing description, the position of the projecting portion **26** in the X direction overlaps with the position of the hopping roller **71** in the X direction. In this regard, the feeding roller **72** and the separation pad **73** are also located at the central portion of the medium conveyance path M in the X direction, and have widths (dimensions in the X direction) substantially equal to the width of the hopping roller **71** in the X direction. Accordingly, it can be said that the position of the projecting portion **26** in the X direction overlaps with the position of the feeding roller **72** in the X direction, or the position of the separation pad **73** in the X direction.

<Control System of Image Forming Apparatus>

Next, a control system of the image forming apparatus **1** will be described. FIG. **14** is a block diagram illustrating the control system of the image forming apparatus **1**. The image forming apparatus **1** includes a controller **200**, an I/F (interface) controller **201**, a reception memory **202**, an image data editing memory **203**, an operation section **204**, sensors **205**, a power supply controller **207**, a head controller **212**, a driving controller **213**, a belt driving controller **214**, a fixing controller **215**, a fixing driving controller **216**, and a feeding and conveying controller **217**.

The controller **200** includes, for example, a microprocessor, a ROM (Read Only Memory), a RAM (Random Access Memory), an input/output port, and a timer. The controller **200** receives print data and control command from a host

device via the I/F controller **201** and controls the operation of the image forming apparatus **1**.

The reception memory **202** temporarily stores the print data input from the host device via the I/F controller **201**. The image data editing memory **203** receives the print data stored in the reception memory **202**, and stores image data formed by editing the print data.

The operation section **204** includes a display (for example, LEDs) for displaying a state of the image forming apparatus **1**, and an operation unit (for example, a switch) with which an operator inputs instructions. The sensors **205** include various sensors for monitoring the operation state of the image forming apparatus **1**. For example, the sensors **205** include a sheet position sensor, a temperature and humidity sensor, and a density sensor.

The power supply controller **207** controls a charging voltage power source **208**, a developing voltage power source **209**, a supplying voltage power source **210**, and a transfer voltage power source **211**. The charging voltage power source **208** applies a charging voltage to the charging roller **12**. The developing voltage power source **209** applies a developing voltage to the developing roller **15**. The supplying voltage power source **210** applies a supplying voltage to the supplying roller **16**. The transfer voltage power source **211** applies a transfer voltage to the transfer roller **81**. The head controller **212** sends the image data stored in the image data editing memory **203** to the printing head **13** and controls light emission of the printing head **13**.

The driving controller **213** controls the driving motor **219** for rotating the photosensitive drum **11** of each process unit **10**. The charging roller **12** rotates to follow the rotation of the photosensitive drum **11**, and the developing roller **15** and the supplying roller **16** rotate by rotation transmitted from the photosensitive drum **11**. The belt driving controller **214** controls a belt motor **220** for driving the transfer belt **82**.

The fixing controller **215** includes a temperature control circuit, and supplies a current to the heater **221** of the fixing device **9** according to a signal output from a thermistor **222** of the fixing device **9**. The fixing driving controller **216** controls the fixing motor **223** for rotating the fixing roller **91** (FIG. **1**) of the fixing device **9**.

The feeding and conveying controller **217** controls a feeding and conveying motor **224** and electromagnetic clutches **225** for rotating the hopping roller **71**, the feeding roller **72**, and the conveying rollers **74** and **75**.

<Operation of Image Forming Apparatus>

Next, an operation of the image forming apparatus **1** will be described with reference to FIGS. **1** and **14**. The image forming apparatus **1** performs an image forming operation in a state where the toner cartridge **3** is mounted on the unit main body **2** of each process unit **10** as described above.

The controller **200** of the image forming apparatus **1** starts the image forming operation, upon receiving print command and print data from the host device via the I/F controller **201**. The controller **200** temporarily stores the print data in the reception memory **202**, creates image data by editing the stored print data, and stores the image data in the image data editing memory **203**.

The controller **200** causes the feeding and conveying controller **217** to drive the feeding and conveying motor **224** and the electromagnetic clutches **225** to rotate the hopping roller **71** and the feeding roller **72**. The hopping roller **71** delivers the medium P from the tray **70**, and the feeding roller **72** feeds the delivered medium P to the medium conveyance path. The conveying rollers **74** and **75** rotate and convey the medium P (fed to the medium conveyance path) to the image forming section **5**.

The controller **200** causes the belt driving controller **214** to drive the belt motor **220** so as to rotate the driving roller **83** and make the transfer belt **82** travel. The transfer belt **82** holds the medium P by suction, and conveys the medium P. The medium P passes through the process units **10**K, **10**Y, **10**M, and **10**C in this order.

The controller **200** performs image formation in each process unit **10** to form a toner image of the corresponding color. More specifically, the controller **200** causes the power supply controller **207** to apply the charging voltage, the developing voltage, and the supplying voltage to the charging roller **12**, the developing roller **15**, and the supplying roller **16**, respectively, of each process unit **10**.

The controller **200** also causes the driving controller **213** to rotate the driving motor **219** to rotate the photosensitive drum **11**. As the photosensitive drum **11** rotates, the charging roller **12**, the developing roller **15**, and the supplying roller **16** also rotate. The charging roller **12** uniformly charges the surface of the photosensitive drum **11** with the charging voltage.

The controller **200** causes the head controller **212** to control light emission of the printing head **13** according to the image data of each color. The printing head **13** emits light to expose the surface of the photosensitive drum **11** to form an electrostatic latent image.

The electrostatic latent image formed on the surface of the photosensitive drum **11** is developed by the toner (adhering to the developing roller **15**) and a toner image is formed on the surface of the photosensitive drum **11**. When the toner image comes close to a surface of the transfer belt **82** by the rotation of the photosensitive drum **11**, the power supply controller **207** applies the transfer voltage to the transfer roller **81**. With the transfer voltage, the toner image formed on the photosensitive drum **11** is transferred to the medium P on the transfer belt **82**.

In this manner, the toner images of the respective colors formed by the process units **10**K, **10**Y, **10**M, and **10**C are transferred to the medium P in an overlapping manner. The medium P to which the toner images of respective colors are transferred is further conveyed by the transfer belt **82** and reaches the fixing device **9**.

In the fixing device **9**, the heater **221** is heated by the fixing controller **215**, and the fixing roller **91** is rotated by the fixing motor **223**. The medium P conveyed to the fixing device **9** is heated and pressed between the fixing roller **91** and the pressure roller **92**, and the toner image is fixed to the medium P.

The medium P with the fixed toner image is ejected outside the image forming apparatus **1** by the ejection rollers **77** and **78** and is stacked on the stacker portion **79**. The image forming operation on the medium P is thus completed.

In this image forming operation, the rotation of the photosensitive drum **11** is transmitted to the waste toner conveying spiral **51**, and the waste toner conveying spiral **51** rotates. The transfer residual toner adhering to the surface of the photosensitive drum **11** passes the seal member **18** to reach the cleaning blade **41**, and is scraped by the cleaning blade **41**, as illustrated in FIG. **12**.

The toner scraped by the cleaning blade **41** falls into the waste toner storage section **40** and is conveyed in the conveying direction (the direction indicated by the arrows F in FIGS. **6** to **10**) by the waste toner conveying spiral **51**.

The waste toner conveyed by the waste toner conveying spiral **51** reaches the waste toner conveying belt **62** (FIG. **7**) in the side frame **22** through the cylindrical portion **53** (FIG. **6**), is conveyed to the waste toner supplying section **61** (FIG.

6) by the waste toner conveying belt **62**, and is stored in the waste toner storage chamber **302** (FIG. **2**) of the toner cartridge **3**.

As described above, paper dust on the medium P generated by contact between the medium P and the hopping roller **71** (or the feeding roller **72** or the separation pad **73**) sticks to the central portion of the photosensitive drum **11** in the X direction upon transferring of the toner image. The toner mixed with the paper dust is scraped by the cleaning blade **41** and falls in the central portion of the waste toner storage section **40** in the X direction.

At the central portion of the waste toner storage section **40** in the X direction, the waste toner conveying spiral **51** is pushed toward the photosensitive drum **11** by the projecting portion **26**, and thus the space around the waste toner conveying spiral **51** is narrow. Therefore, the waste toner whose flowability is lowered by mixture with paper dust is efficiently conveyed by the waste toner conveying spiral **51**, and accumulation of the waste toner is inhibited. This makes it possible to inhibit leakage of the waste toner from the waste toner storage section **40**.

FIGS. **15**A to **15**D are schematic views illustrating the waste toner storage section **40** and its surroundings, after the process unit **10** is mounted on the main body of the image forming apparatus **1** and until the image forming operation is completed.

In a state illustrated in FIG. **15**A, the process unit **10** is mounted on the main body of the image forming apparatus **1**, but the image forming operation is not yet started. In this state, no waste toner is stored in the waste toner storage section **40**.

As illustrated in FIG. **15**B, when the image forming operation is started, the toner (i.e., the transfer residual toner) adhering to the surface of the photosensitive drum **11** is scraped by the cleaning blade **41**, and falls and is stored in the waste toner storage section **40**.

As illustrated in FIG. **15**C, as the image forming operation proceeds, the amount of waste toner stored in the waste toner storage section **40** increases. In the waste toner storage section **40**, the waste toner reaching the height of the waste toner conveying spiral **51** is conveyed by the waste toner conveying spiral **51**.

As illustrated in FIG. **15**D, when the image forming operation is stopped, the waste toner conveying spiral **51** stops conveying the waste toner. In the above described state illustrated in FIG. **15**C, the waste toner is efficiently conveyed by the waste toner conveying spiral **51**, and thus accumulation of the waste toner is inhibited.

In the operation states illustrated in FIGS. **15**A to **15**D, a curved state of the waste toner conveying spiral **51** (i.e., the curved state illustrated in FIG. **10**) is constant. Thus, the conveyance capability of the waste toner conveying spiral **51** can be kept constant.

Effects of First Embodiment

As described above, the process unit (image forming unit) **10** according to the first embodiment includes the waste toner storage section (developer storage section) **40**, the base frame (frame) **25** surrounding the waste toner storage section **40**, and the waste toner conveying spiral **51** that conveys the waste toner in the waste toner storage section **40** in the predetermined conveying direction. The base frame **25** has the projecting portion (convex portion) **26** that pushes the waste toner conveying spiral **51** toward the photosensitive drum **11**.

The waste toner conveying spiral **51** is curved toward the photosensitive drum **11** by the projecting portion **26**, and thus the waste toner conveyance efficiency is enhanced. As a result, the waste toner whose flowability is lowered by mixture with paper dust can be efficiently conveyed, and leakage of the waste toner can be inhibited.

In particular, the projecting portion **26** is disposed at the central portion of the waste toner storage section **40** in the X direction. Thus, in the image forming apparatus **1** having the hopping roller **71** disposed at the central portion in the X direction, the waste toner mixed with paper dust generated when the medium P is delivered by the hopping roller **71** can be efficiently conveyed by the waste toner conveying spiral **51**.

The position of the projecting portion **26** in the X direction at least partially overlaps with the position of the hopping roller **71** in the X direction. Hence, the waste toner mixed with paper dust generated when the medium P is delivered by the hopping roller **71** can be efficiently conveyed by the waste toner conveying spiral **51**.

The projecting portion **26** includes inclined portions **26***b* on both sides in the X direction. Hence, the waste toner conveying spiral **51** can be smoothly curved in an arcuate shape, and the rotation load of the waste toner conveying spiral **51** can thus be reduced.

Since the waste toner conveying spiral **51** is formed by a spirally wound wire, the waste toner conveying spiral **51** can be curved by being pushed by the projecting portion **26**, and can convey the waste toner while rotating in the curved state.

Since the wire of the waste toner conveying spiral **51** is made of metal, the waste toner conveying spiral **51** is not damaged even when it rotates in contact with the projecting portion **26**.

The conveying direction of the waste toner by the waste toner conveying spiral **51** is parallel to the rotation axis of the photosensitive drum **11**. Hence, the waste toner scraped from the photosensitive drum **11** can be conveyed to one end of the photosensitive drum **11** in the axial direction, and then the waste toner can be conveyed therefrom to a predetermined storage chamber (for example, the waste toner storage chamber **302** of the toner cartridge **3**).

The rotation of the photosensitive drum **11** is transmitted to the waste toner conveying spiral **51** by the transmission gear (rotation transmitting member) **54**. Hence, the waste toner can be conveyed using the rotation of the photosensitive drum **11**, and it is not necessary to provide an independent drive source.

The projecting portion **26** projects from the first wall portion **25***a* of the base frame **25** toward the photosensitive drum **11**. Hence, the waste toner conveying spiral **51** can be curved with a simple structure, and the conveyance efficiency can be enhanced.

Since the cleaning blade **41** is provided, the toner adhering to the surface of the photosensitive drum **11** can be scraped therefrom and fall into the waste toner storage section **40**.

The sponge member **45** is disposed in contact with the waste toner conveying spiral **51**. Hence, the waste toner conveyance efficiency can be enhanced by limiting the capacity of the waste toner storage section **40**.

The gap between the base frame **25** and the photosensitive drum **11** is closed by the seal member (film member) **18**. Hence, leakage of the waste toner from the waste toner storage section **40** can be inhibited.

First Modification

Next, a first modification of the first embodiment will be described. FIG. **16** is a schematic view illustrating a posi-

tional relationship among a waste toner conveying spiral **51**, a projecting portion **26**, and a hopping roller **71** in the first modification.

In the above described first embodiment, both of the projecting portion **26** and the hopping roller **71** are disposed at the central portion of the medium conveyance path M in the X direction (see FIG. **13**). In contrast, in the first modification, both of the projecting portion **26** and the hopping roller **71** are disposed on the −X side (i.e., a downstream side along the conveying direction indicated by the arrow F) of the central portion of the medium conveyance path M in the X direction.

Even in the first modification, the position of the projecting portion **26** in the X direction overlaps with the position of the hopping roller **71** in the X direction, as indicated by an arrow X1. More specifically, the waste toner conveying spiral **51** is pushed toward the photosensitive drum **11** by the projecting portion **26** located in correspondence with the position of the hopping roller **71** in the X direction. Therefore, the waste toner whose flowability is lowered by mixture with paper dust can be efficiently conveyed by the waste toner conveying spiral **51**. This makes it possible to inhibit accumulation of the waste toner.

If the waste toner conveying spiral **51** is disposed closer to the photosensitive drum **11** as a whole, the capacity of the waste toner storage section **40** decreases, and thus the waste toner conveyance capability may decrease. In the first modification, the waste toner conveying spiral **51** is disposed closer to the photosensitive drum **11** only at a portion where the waste toner mixed with paper dust falls. Therefore, accumulation of the waste toner mixed with paper dust can be inhibited, and decrease in the waste toner conveyance capability can be inhibited.

FIG. **16** illustrates the positional relationship between the projecting portion **26** and the hopping roller **71**. However, the feeding roller **72** and the separation pad **73** (FIG. **1**) are disposed on the −X side of the central portion of the medium conveyance path M in the X direction similarly to the hopping roller **71**, and have widths (dimensions in the X direction) substantially equal to that of the hopping roller **71**. Accordingly, it can be said that the position of the projecting portion **26** in the X direction overlaps with the position of the feeding roller **72** in the X direction, or the position of the separation pad **73** in the X direction.

Second Modification

Next, a second modification to the first embodiment will be described. FIG. **17** is a schematic view illustrating a positional relationship among a waste toner conveying spiral **51**, a projecting portion **26**, and a hopping roller **71** in the second modification.

In the second modification, both of the projecting portion **26** and the hopping roller **71** are disposed on the +X side (i.e., an upstream side along the conveying direction indicated by the arrow F) of the central portion of the medium conveyance path M in the X direction.

Even in the second modification, the position of the projecting portion **26** in the X direction overlaps with the position of the hopping roller **71** in the X direction, as indicated by an arrow X1. More specifically, the waste toner conveying spiral **51** is pushed toward the photosensitive drum **11** by the projecting portion **26** located in correspondence with the position of the hopping roller **71** in the X direction. Therefore, the waste toner whose flowability is lowered by mixture with paper dust can be efficiently conveyed by the waste toner conveying spiral **51**. This makes it possible to inhibit accumulation of the waste toner.

If the waste toner conveying spiral **51** is disposed closer to the photosensitive drum **11** as a whole, the capacity of the waste toner storage section **40** decreases, and thus the waste toner conveyance capability may decrease. In the second modification, the waste toner conveying spiral **51** is disposed closer to the photosensitive drum **11** only at a portion where the waste toner mixed with paper dust falls. Therefore, accumulation of the waste toner mixed with paper dust can be inhibited, and decrease in the waste toner conveyance capability can be inhibited.

FIG. **17** illustrates the positional relationship between the projecting portion **26** and the hopping roller **71**. However, the feeding roller **72** and the separation pad **73** (FIG. **1**) are disposed on the +X side of the central portion of the medium conveyance path M in the X direction similarly to the hopping roller **71**, and have widths (dimensions in the X direction) substantially equal to that of the hopping roller **71**. Accordingly, it can be said that the position of the projecting portion **26** in the X direction overlaps with the position of the feeding roller **72** in the X direction, or the position of the separation pad **73** in the X direction.

An image forming apparatus that forms a color image has been described in the above described embodiments. However, the present invention is also applicable to an image forming apparatus that forms a single-color (monochrome) image. The present invention may be applied to, for example, an image forming apparatus (e.g., a copier, a facsimile machine, a printer, or a multifunction peripheral) that forms an image on a medium using an electrophotographic scheme.

While the preferred embodiments of the present invention have been illustrated in detail, it should be apparent that modifications and improvements may be made to the invention without departing from the spirit and scope of the invention as described in the following claims.

DESCRIPTION OF REFERENCE CHARACTERS

1 image forming apparatus; **2** unit main body; **3** toner cartridge (developer storage body); **5** image forming section; **7**A medium supplying section; **7**B medium ejection section; **8** transfer unit; **9** fixing device; **10**, **10**K, **10**Y, **10**M, **10**C process unit (image forming unit); **11** photosensitive drum (image bearing body); **11***a* drum gear; **12** charging roller (charging member); **13**, **13**K, **13**Y, **13**M, **13**C printing head (exposure device); **14** developing section; **15** developing roller (developer bearing body); **16** supplying roller (supplying member); **17** developing blade (developer regulation member); **18**, **19** seal member (film member); **20** main body frame; **22** side frame; **25** base frame (frame); **25***a* first wall portion; **25***b* second wall portion; **25***c*, **25***d* side wall portion; **25***e* opening; **25***f* bottom plate portion; **26** projecting portion (convex portion); **26***a* central portion; **26***b* inclined portion; **29** mounting section; **30** outer case; **40** waste toner storage section; **41** cleaning blade (cleaning member); **42** blade holder; **45** sponge member; **51** waste toner conveying spiral (developer conveying member); **52** spiral holder; **52***a* gear portion; **52***b* shaft portion; **53** cylindrical portion; **54** transmission gear (rotation transmitting member); **61** waste toner supplying section; **62** waste toner conveying belt (conveying member); **70** tray (medium storage section); **71** hopping roller (delivery member); **71***a* roller

shaft; **72** feeding roller; **73** separation pad; **74**, **75** conveying rollers; **77**, **78** discharging rollers; **200** controller.

What is claimed is:

1. An image forming unit comprising:

an image bearing body;

a developer storage section that stores a developer removed from a surface of the image bearing body;

a frame surrounding the developer storage section;

a developer conveying member that conveys the developer in the developer storage section in a predetermined conveying direction; and

a convex portion that is provided in the frame and pushes the developer conveying member toward the image bearing body.

2. The image forming unit according to claim **1**, wherein the convex portion is located at a central portion of the developer storage section in the conveying direction.

3. The image forming unit according to claim **2**, wherein the convex portion includes inclined portions provided on both sides of the convex portion in the conveying direction, the inclined portions being inclined with respect to the conveying direction.

4. The image forming unit according to claim **1**, wherein the image forming unit forms an image on a medium supplied from a medium supplying section having a delivery member that delivers the medium, and

wherein a position of the convex portion in the conveying direction at least partially overlaps with a position of the delivery member in the conveying direction.

5. The image forming unit according to claim **4**, wherein the convex portion is located at one side of a central portion of the developer storage section in the conveying direction.

6. The image forming unit according to claim **1**, wherein the developer conveying member comprises a spiral formed by a spirally wound wire.

7. The image forming unit according to claim **6**, wherein the wire is made of metal.

8. The image forming unit according to claim **1**, wherein the image bearing body is rotatable about a rotation axis, and the conveying direction is parallel with a direction of the rotation axis of the image bearing body.

9. The image forming unit according to claim **8**, further comprising a rotation transmitting member that transmits rotation of the image bearing body to the developer conveying member.

10. The image forming unit according to claim **1**, wherein the convex portion comprises a projecting portion that projects from an inner surface of the frame toward the developer conveying member.

11. The image forming unit according to claim **1**, further comprising a cleaning member that removes the developer from the surface of the image bearing body.

12. The image forming unit according to claim **11**, wherein the developer conveying member is disposed below the cleaning member.

13. The image forming unit according to claim **1**, further comprising a sponge member disposed in contact with the developer conveying member.

14. The image forming unit according to claim **1**, further comprising a film member that closes a gap between the frame and the image bearing body.

15. The image forming unit according to claim **1**, further comprising:

a charging member that charges the surface of the image bearing body; and

a developing section that develops a latent image formed on the surface of the image bearing body.

16. An image forming apparatus comprising:

a medium supplying section that supplies a medium, the medium supplying section comprising a delivery member that delivers the medium;

the image forming unit according to claim **1**, the image forming unit forming an image on the medium supplied from the medium supplying section; and

a fixing device that fixes the image formed on the medium by the image forming unit.

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